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WESTERN WATER DEVELOPMENT

Status of Water Development in Eleven Western States
Present Problems in Concrete Dam Design
New Developments in Western Municipal Water Supply Practice
Ariel Dam, An Example of Modern Construction
Economic Aspects of Land Reclamation in Oregon
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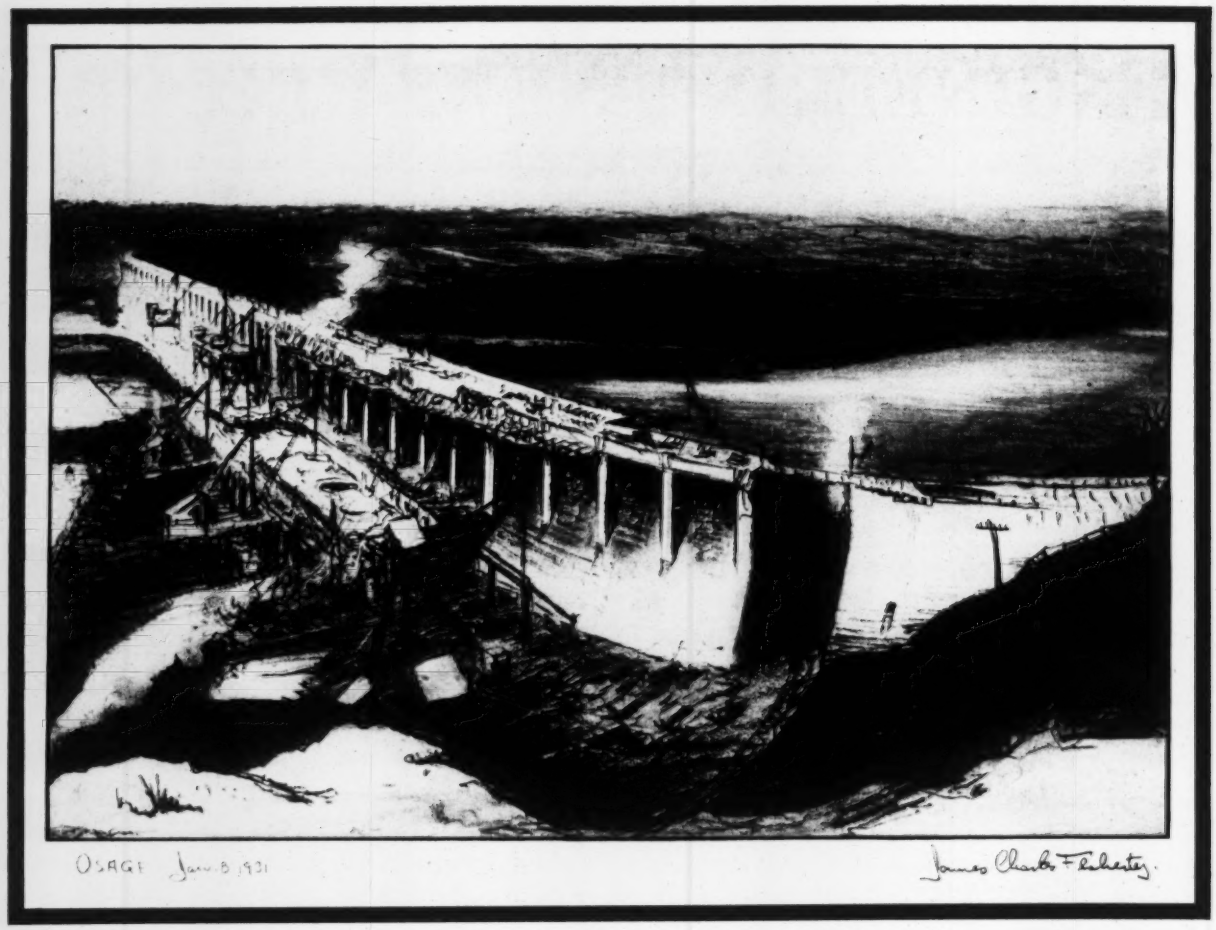

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 106 NEW YORK, MARCH 12, 1931 Number 11

Big Figures in the News

THE low bid made last week for the contract to build Hoover Dam was close to $49,000,000, but this figure does not reveal the full magnitude of the undertaking, as the federal government is to supply the cement, give the contractor free access to sand and gravel deposits and supply all permanent material and equipment going into the dam and power house. Another job of equal magnitude in the week's news is the second pair of vehicular tunnels under the Hudson River at New York, estimated to cost $96,000,000. This job is far from the bidding stage, but approval of the undertaking by the states of New York and New Jersey means that the preparatory work will now be pushed. At Chicago, a bond issue of $36,000,000 for new work by the Sanitary District has been approved and a $2,700,000 contract for sewage-treatment works has been let. At Boston, within a few days, bids will be asked on a 10.4-mile extension of the city's 24.6-mile water tunnel; bids already have been taken on the first section of the $16,000,000 vehicular tunnel to East Boston. A contract has been let for a $2,000,000 dam at Pittsburgh, and at Philadelphia bids are asked on a $5,000,000 extension of the Broad Street subway. These are encouraging signs of an upturn in the construction industry.

Cities of the Future

A GLIMPSE of the city of the future as city plan experts have been predicting it for several years is afforded in our news pages this week, where work on the "Metropolitan Square" development in New York City, fostered by John D. Rockefeller, Jr., is announced as definitely to begin in June. It is a unique and stupendous project that has been planned. Occupying three city blocks each 200 by 600 ft. and involving one skyscraper of 68 stories and two of 45 stories, as well as half a dozen others ranging in height from 14 stories upward, Metropolitan Square represents the first real test of group planning for commercial as distinguished from public buildings. The cost is estimated to be approximately a quarter of a billion dollars, which in itself is good news for the construction industry. Complete details of the new buildings are still unavailable, but large open broadcasting rooms in the tallest of the structures, several theaters, an opera house and an unusual building elliptical in plan promise interesting problems for the structural engineer and the builder. It is to city planners, however, that the project has greatest appeal, embodying as it does one of their most popular theories—namely, that large areas of a city should be developed from a master plan that assures a proper balance of light and air and adequate transportation and parking facilities. To these engineers and architects, as well as to all civic minded persons the country over, the details of the actual planning are vital and important. It is to be hoped that those in charge of the project will make these details public as soon as possible, analyzing not only the plan as adopted but the various suggestions that were rejected. Radio City, as Metropolitan Square has come popularly to be known, may set a precedent that will vitally influence the next great rebuilding of our large cities.

Remarkable Earth Moving

A NOTABLE earth-moving performance was recorded in constructing the Greenville levee described in this issue. It is interesting to observe also that the record was made with one of the oldest types of levee-building machines used on the Mississippi River and with machines which, although well kept up, had given many years of previous service and which had not been originally designed to go so far away for material. Credit for the excellent performance is therefore due not only to the capability of the tower excavator as a levee builder but also to the skill with which the work was planned and prosecuted. It is the organization and morale of the working forces that are deservedly emphasized in the article in this issue by the directing officer of the flood-control work. The actual volumes handled, however, command attention. The four tower excavators placed 685,000 cu.yd. a month for five months, or more than 170,000 cu.yd. a month for each machine. In the record month of the five, 859,257 cu.yd., or nearly 215,000 cu.yd. for each machine, was placed. These records of embankment construction from borrowpits have, we think, seldom been exceeded.

Bridges and Approach Roads

THE influence of important bridges extends far beyond their approaches. Realization of this fact is sometimes tardy and necessary revamping of regional traffic systems too long delayed, resulting in congestion and inefficiency. At present there seems to be a possible danger that something of this sort may befall the San Francisco-Oakland bridge project. Progress on the actual bridge planning has been both rapid and well directed since the favorable report of the Hoover-Young commission six months ago. Requirements of the war and navy departments apparently have been satisfied, although the former has yet to consider the final plans and specifications. An act of Congress is necessary to provide a right-of-way across Goat Island, but with no official objections from either the navy or the war department the Kahn bill granting such right should meet slight opposition. Local opposition has been quieted

by increasing the span length and clearance proposed for the east end of the bridge, as requested by the Oakland port authorities to protect their harbor development, and the East Bay region is now solidly behind the project. Meanwhile steps are being taken to test the validity of the state toll-bridge authority act, upon which the sale of $70,000,000 worth of revenue bonds depends. These developments denote progress, but in the meantime the public seems to be about ready to sit back and watch for the rise of tall piers and the erection of steel. Herein lurks a possible danger that those directing the project should not overlook. The bridge project itself is in able hands and may be expected to go along well, but municipal officials and the public at each terminus should be made to appreciate the task of equal or greater complexity that confronts them in preparing new transportation routes and facilities. Much needs to be done in the way of study and planning for these far-reaching alterations in the traffic systems of these two metropolitan areas if the maximum advantage of the bridge is to be realized. Unless this work keeps pace with plans of the actual structure, serious and inexcusable complications will result and the full value of the bridge as a traffic artery may not be realized.

Restated Principles

PERIODICALLY it is worth while to restate and emphasize certain basic and elementary principles of engineering design. Such relatively simple problems as designing combined footings, proportioning retaining walls, calculating moments of inertia of complicated sections or locating reinforcement in concrete slabs and beams are sometimes troublesome if one's practice has not embraced them for a considerable time. Young engineers who have not encountered such problems since leaving the college classroom benefit from a restatement of principles. And there is always the puzzled layman with a legitimate curiosity which results in his questioning the safety of certain structures, and his support and admiration can often be gained by a simple explanation. Suspension bridges because of their current widespread construction suggest such a basic analysis at the present time, particularly with reference to cable design principles. Only recently the stability of the Fort Lee bridge towers was questioned because of the noticeably unequal angles by which the backstay and main span cables intersect the tower tops. It is perhaps natural for one not familiar with design methods to visualize a necessity for equal cable pulls on either side of the tower to assure stability, when the truth is that only the horizontal components of the cable stresses need be equal. The vertical components can be and on most bridges are quite unequal. But with equal horizontal components, regardless of the magnitude of the vertical components, a force polygon can be drawn whose resultant is vertical and safely within the tower base. It is a fact that the horizontal components may become temporarily unequal under particular types of cable loading, and such a condition is foreseen by providing for enough adjusting movement of the cables that equality will be immediately reestablished. This necessary adjustment may be provided by using towers hinged at the base (with cables fixed), by placing the cables on rollers at the tower top or by designing the towers as flexible structures which will bend. All of these expedients permit equilibrium to be reestablished once it has been upset.

Flood-Control Plan Upheld

NO PROFIT in altering the present plan of flood control on the lower Mississippi River is perceived by Major General Lytle Brown, Chief of Engineers, U. S. Army. Neither does he consider that greater expenditure than is now provided for flood protection is economically justified. In his report to Congress after a review and restudy of the Jadwin plan, with three years' accumulation of additional data in hand, the head of the army engineers dismisses all substitute engineering solutions and reaffirms the doctrine announced by his predecessor in office that no flowage or flood damages be paid by the United States for the use of the Boeuf and Atchafalaya basins as diversion channels for extraordinary floods.

The report commands respect for its courage. About every conclusion is counter to beliefs held by strong groups of engineers. Reservoirs, higher levees and river straightening are stricken out of the list of practicable flood-control plans, and the plan of partial levee control, with diversion of high floods, is alone approved as keeping within the bounds of justified expenditures. Also, choice for this diversion, of the natural floodways of the Boeuf and Atchafalaya valleys, is considered unescapable. The only concession made is that narrow cleared channels with fixed weirs are the ultimate solution of the floodway problem. It is qualified, however, by the assumption that, at present, cost and doubts of adequate maintenance do not encourage the immediate planning of such channels.

Without comment now on the individual items of the engineering project, it is plain that the review of the flood-control plan for which the river interests have waited so long leaves all the conflicting opinions in the same old battle array. Congress will again be the battle ground. In the new line-up, the New Madrid widening and the Bonnet Carré diversion, both of which will be virtually completed before Congress assembles again, will be missing elements of conflict, and fighting will center about the west shore diversions in lower Arkansas and in Louisiana. The questions to be settled are: Shall the extra cost of weir-controlled, narrow, cleared floodways be undertaken and shall the United States assume the cost of flowage rights and flood damages in the floodways? It may be accepted that with these questions disposed of the more strictly river-engineering problems of channel rectification and bank protection will work themselves out through experience and research.

General Brown's report merits the distinction of stating definitely the Mississippi flood-control problem as it is viewed by the federal engineers. There is no ambiguity or subterfuge in opinion or conclusion. The contentions that present appropriations are as great as are economically justified, that diversion of flood peaks is the logical engineering plan and that compensation for flowage and flood damages are not federal responsibilities are straightforward and positive.

The question that may be well asked is whether it is the function of the Chief of Engineers to advise on the policy of paying land damages. This is the perogative of Congress and the courts. Whether the nation or the local governments pay the cost, the economics of the engineering project are not affected, and the only duty of the engineer is to advise on the plan that best fits the economics of the project. General Brown does this so positively that his advice on allocation of responsibility for land damages seems gratuitous.

The West and Its Waters

THE mountain and transmountain regions of the West live on water. All but the narrow north-coast fringe of that great section of this country is either semi-arid or desert, and from earliest days could build up community life and civilization only by virtue of the labors of those who made its scanty waters available for use. It will continue to depend on water development for its progress, but under more severe conditions. The civil engineer's tasks in this work are of growing size and complexity. For their better understanding a series of special articles on water in the West is brought together in this issue of *Engineering News-Record*. Written by men who are intimately concerned with the chief phases of the water problem, they invite thoughtful study.

First among the controlling factors of the situation is the decreasing margin of water resources in the eleven Western states. In that vast territory, more than one-third the area of the United States, residual waters only are available for further growth. The normal flow of streams has been largely appropriated; future dependence must be on the floodflow that can be saved by storage, and to a minor degree on underground waters. The character as well as the magnitude of water-development work is determined thereby. Water costs are bound to rise, but the value of water is rising even faster.

Open questions as to control of water complicate the use of these remaining resources. There is yet a no man's land in the law of water rights. A decision of the California courts some years ago which recognized and protected riparian ownership of floodflow, harmful as well as useful, set up a further incidental obstacle. But the principal difficulty lies in the overlap of state and federal authority, because of public lands, navigation, power and flood control. Cooperation between state and nation in carrying out enterprises of joint benefit has rarely or never been resorted to; it may prove to be a potent agency of progress.

That the future use of water in the West is narrowly limited has received sharp emphasis by subnormal precipitation during the past decade. Additional limitations have come to light through evolving experience in irrigation and changes in power economics. Irrigation declined sharply in area in some of the northern states since 1920, and for the entire region increased only 1 per cent; costly trials proved that marginal lands cannot use water profitably. Power has been turning toward steam, because of cheap oil and gas, increased generating efficiency, and cost and remoteness of water powers. Thus the water engineer's work has been modified by economic changes in addition to the physical limitations, and its success is contingent on careful appraisals of these influences.

Joint use of water is one response to the new conditions. The recent extension of power-and-irrigation reservoir use is doubtless only the beginning of such development. Not alone the growing cost of water but also clearer appreciation of the vital nature of water resources directs attention to broad study of joint service. Because of its size the Boulder Canyon project is the leading instance of what may be achieved in this direction, but it merely expresses the trend. Wherever possible, the demands of municipal, irrigation, flood-control, and power service will be combined in a single solution, for it is imperative that fullest economic utilization of water be attained. Hence also the need for careful study of the re-use of water, even in the form of purified sewage effluent, as contemplated in southern California.

It is apparent that under such circumstances the engineering operations of water development will be of large scale. Size and boldness have ever characterized the Western civil engineer's work; his imaginative genius and pioneer resourcefulness have made many lasting contributions to the art. But future requirements will lead to still larger magnitude and to difficulties that will tax the engineer's originality. In one leading element, the construction of great storage dams, the art has already progressed to the limits of its present power, and keen study is being directed to its advancement as reflected in a masterly discussion in this issue. High dams are preeminently worthy of penetrating scientific study and sane exercise of engineering judgment, with judgment in final control.

A necessary foundation of sound progress in water development is thorough knowledge of water resources and carefully studied programs for their utilization. Various agencies have been collecting water data for years, but much remains to be done, as shown by many unexpected water shortages during the last few years. Mere cataloging of the waters can accomplish little, however. It is essential that a consistent program be set up by each state, to assure that every future enterprise will form part of a coordinated program fitted to the best interests of the entire community. Interstate waters, which create the most serious difficulties, demand earliest study to forestall future disagreements, but utilization programs for state waters are of equal ultimate importance. On comprehensive advance planning of water development depends the future growth of the West.

Higher Construction Efficiency

AS CONSTRUCTION goes forward into its busiest working season, the signs point toward a strenuous year. Competition is exceptionally sharp, despite the unprecedented volume of public works that is on the year's construction budget. The pressure is not likely to be relieved even in the months of most active roadbuilding, for the different fields of construction are closely interrelated and each affects the others.

Construction prices that average 20 per cent below those of 1929 represent something more than merely taking advantage of cheap materials and efficient labor. They mean that contractors have sharpened their pencils to a fine point and are doing exceedingly close figuring on costs and profits. And this in turn means that higher efficiency is the only tool likely to prove effective in meeting the special demands of the season. Keener construction planning, more ingenuity and resourcefulness in devising methods, better coordination of plant and man power, will prove to be the keys to success. Without them, contractors will not be able to meet the requirements of low price, rapid completion and high quality of work that the year's competition imposes.

Much progress in efficiency has been made by the construction art during the past decade or two. Yet the present demands for still higher efficiency are to be welcomed in the interests of the art itself. Every industry now is facing new tests, and is meeting them by reviewing its problems, restudying its equipment and organization, reestablishing its working principles and developing improved methods. The construction industry, if it is to keep pace with its fellows, must also move on to greater perfection.

Status of Water Development in the Eleven Western States—

A Symposium

Opinions of state officials on problems of water utilization and the adequacy of existing water codes

CONTINUED DEVELOPMENT and growth in the territory which comprises the eleven Far Western states will be dependent, in large measure, upon the conservation and economic utilization of the water resources in that region. The era of cheap water secured by direct application of streamflow is passing; future demands must be met by the storing of floodflows. Unit costs will rise, directing attention to further consideration of the dual irrigation-power principle of development supplemented by additional allocations of costs to flood control and the more indirect benefits to adjacent urban centers. There follow statements by officials of eleven of the Far Western states, indicating the scope of the present problem and some present trends in meeting questions of water development in the West. —EDITOR.

Washington—Low Rainfall Stimulates Irrigation West of the Cascades

By CHARLES J. BARTHOLET
Supervisor of Hydraulics, Olympia

IRRIGATION development during the past decade has been slow in Washington, although the past biennium has witnessed a slight acceleration in spite of the general low return for agricultural products. It is of particular interest to note that on the west slope of the Cascades, where crops formerly were matured by normal moisture, irrigation is now necessary to produce the best results. Agricultural authorities are encouraging irrigation for lands in this section of the state, and it is considered probable that, unless the annual rainfall returns to normal, irrigation developments in western Washington will increase noticeably during the next few years, stimulated by an ample runoff in that section and the low cost of application. At present 616,600 acres of land is irrigated, and water is available for 2,480,900 additional acres, including 1,800,000 acres in the Columbia River basin. On many streams the available water has been taken as normal streamflow only, with the floodwaters as yet untouched.

There are 71 hydro-electric power plants now in operation, with a total capacity of 708,435 hp. In addition, several major developments are under construction, which will add 406,200 hp. to the present output. With the completion of these projects the ultimate water power of the state will be 13½ per cent developed. The west slope of the Cascade and Olympic ranges has short steep streams, precipitation from 80 to 140 in. per year and sustained flow fed by snow fields and glaciers; thus the region is particularly favorable for development of hydro-electric power.

The present water code, passed in 1917, appears entirely adequate. Although riparian rights are not referred to specifically in the code, they are recognized by inference. However, there is a tendency for the court to modify the riparian doctrine and render it of little value unless the right has been exercised. In 90 per cent of the adjudications the water rights are based on the appropriation doctrine, and the decisions are not appealed. Through cooperation between state agencies and the U. S. Geological Survey a program has been developed for studying the water resources of the state.

Nevada—Appropriations Are Mainly for Stock Watering on the Public Domain

By GEORGE W. MALONE, *State Engineer*

MOST of the applications for water filed during the past four years have been for stock watering on the public domain. Under the so-called Nevada stock-watering act (1925) the state regulates the stock-raising industry on the 55 million acres of public domain land through the allocation of water for stock-watering purposes. These rights are apportioned not so much according to the water available as according to the amount of stock feed on adjacent lands; in other words, the regulation is based on a definite relation between water supply and range value. The courts have ruled in favor of the act, recognizing the right of the state to prescribe police regulations to the public domain in the interest of the general welfare. Unappropriated water supplies consist only of floodwaters, in addition to the underground sources. The estimated area under irrigation is approximately 650,000 acres. Based on the right of appropriation and beneficial use, the present state water code is considered adequate.

California—Plans Completed for First Units of Comprehensive Program

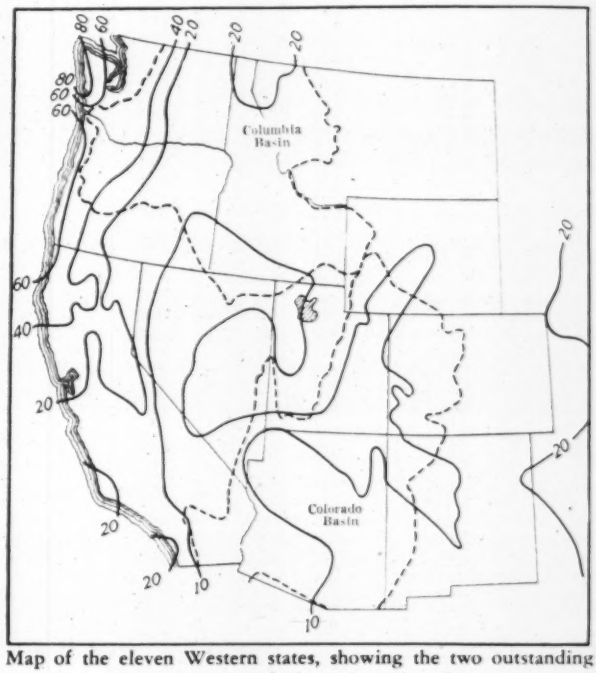
By EDWARD HYATT, *State Engineer*

FOLLOWING a decade of intensive study to establish a program for the most practicable utilization of the state's water resources, a plan for the initial developments has been formed that will be recommended to the legislature. Economically, these first units, costing $375,000,000, are believed justified by the benefits which will result, provided the costs are not assessed entirely against the areas to be served but are in part distributed among other benefited interests, including utilities, urban communities and the state and federal governments. The present comprehensive water study had the benefit of

earlier investigations dating back to 1878, so that a half century of study of the California water problem underlies these more recent recommendations.

The state is sufficiently arid to make a deficiency of water a limiting factor in development. Already the summer flow in major streams is almost completely appropriated, and future development will require storage. Further, certain local areas have their local water supply fully developed and in use. Certain irrigated areas, particularly in southern California and the southern San Joaquin Valley, have even been developed beyond the capacity of their supplies, creating an immediate and serious water problem in merely maintaining the present developments.

The seasonal and geographical distribution of precipitation in the state is extremely unequal. Precipitation occurs almost entirely during a short winter period, and 75 per cent of this supply returns to the ocean within 45 days unless diverted or stored. On this account storage is particularly essential for agricultural use, because the demand comes during the low-flow season. Geographically, 75 per cent of the natural water supply occurs within the most northerly third of the state's area, while 75 per cent of the demand is in the other two-thirds. Thus, full utilization of the available water supplies will involve transportation of the surplus from the northern section to remote areas in the south.



Map of the eleven Western states, showing the two outstanding river systems and the principal isohytes

Further complicating the entire water-development problem, the courts have declared that riparian owners are entitled to restrain any diversion of waters that may be beneficial to their land, without any limitation as to measure of reasonableness in their use or method of use. There is need for a speedy and adequate tribunal which will determine the value of the surplus waters necessary for exportation to areas of deficient natural supply.

Future possibilities are indicated by the fact that the present 6,000,000 acres under irrigation can be increased by another 7,000,000 acres within the range of present economic possibilities. Only about 25 per cent of the state's potential water power has yet been developed.

Idaho—New Areas Must Wait Until Present Acreage Has Assured Supply

By GEORGE N. CARTER, *Commissioner of Reclamation*

FUTURE DEVELOPMENT of irrigation and power in Idaho will to a large extent be interdependent, because of physical conditions. The present policy of the state recognizes the principle that irrigating use is a superior one and that power development should take place where it will reduce the availability of water for irrigation as little as possible. Probably the most important problem will be to assure the adequacy of a supply to present irrigated lands before dedicating water to new areas.

During the past decade the irrigated area has remained approximately constant at 2,500,000 acres. The principal development of the past biennium was on the Milner extension of the Minidoka project, which is of primary importance in relieving the seriously inadequate supply to approximately 100,000 acres in the Wood River district. Another million acres of land is susceptible of irrigation, and water is available with proper storage facilities. Half the real property valuation of Idaho has been created and exists only by reason of irrigation, which produces annual crops valued at $70,000,000. Likewise, half the state's population finds gainful occupation in irrigated agriculture and its associated activities.

The estimated hydro-electric power of the state is approximately 17 per cent developed, estimating the ultimate resources at 2,150,000 hp. if feasible storage is constructed and used for the combined interests of power and irrigation. The present water code of the state, based on appropriated rights, is considered adequate for present needs, with possible minor changes to facilitate administration. A comprehensive program for the development of the state's water resources is being carried out to a limited extent.

Oregon—Hydro-Electric Development a Much-Discussed Question

By CHARLES E. STRICKLIN, *State Engineer*

WITH 54 applications for power permits now pending, aggregating 1,445,180 hp., water power is one of the most widely discussed state problems at this time. The general trend of new legislation would seem to indicate that development will be encouraged rather than discouraged or blocked. From estimates of the U. S. Geological Survey the water power resources of the state are 3,665,000 hp., considering the utilization of feasible storage; the present development is only about 10 per cent of this amount. Even aside from storage possibilities, much unequalized streamflow is still available among the unappropriated waters of the state, particularly in the western section.

The state water code, enacted in 1909, is considered satisfactory. It has been construed by the court to abrogate entirely the riparian theory of water rights. A possible exception as to effective operation of the code may

be found in the matter of provisions regulating appropriation for power development, and it is expected that the next legislature will make changes in the method of acquiring and protecting these rights.

Estimates indicate that about one million acres of land is under irrigation in the state. An additional 400,000 acres is susceptible of economic irrigation by water supplies now available.

Montana—Plans Under Way for Economic Water-Development Program

By J. S. JAMES, *State Engineer*

FUTURE PROGRAMING of water-resource development in Montana will be influenced by the studies now being carried on by the Army engineers. This office is particularly interested at present in helping the reorganization of distressed irrigation districts and securing proper coordination in future irrigation development. With 2,500,000 acres of land now under irrigation and an additional 3,500,000 acres susceptible of development, the orderly development of irrigation in connection with other uses of the water resources is important in realizing a balanced state development.

This problem is intensified by the fact that, as little unappropriated streamflow is left, the source of future supplies must be floodflows conserved by storage reservoirs. The possibility of a development program combining irrigation and power needs is indicated by the fact that only about 20 per cent of the potential water power in the state has been developed. The present water code based on appropriators' rights is not considered adequate, and some efforts are being made to improve the code.

Colorado—Unappropriated Waters in State Confined to Colorado River System

By M. C. HINDERLIDER, *State Engineer*

EAST of the continental divide the water resources of Colorado are already over-appropriated for irrigation uses. This territory contains about 2,600,000 acres under irrigation. The water originating therein will, when properly conserved, be required to make up deficiencies under the existing canal systems. In western Colorado about 900,000 acres is under irrigation, and an additional 1,685,000 acres is susceptible of reclamation, with abundant water supply available. The only unappropriated water in the state today originates in the Colorado River and its tributaries; a large part of the 10,300,000 acre-ft. of water that leaves the state annually down the channel of the Colorado is required to satisfy provisions of the Colorado River compact.

Because of prior irrigation appropriations east of the divide, hydro-electric development probably will be largely confined to the potential 400,000 hp. in the western section. However, these developments would require extensive storage, with resulting high unit cost, and are not likely to be built until they can show economic justification in a state that possesses large and diversified coal deposits. The city of Denver, with its program of storage and transmountain diversion, is one of the largest potential developers of hydro-electric power.

Present laws governing use of water, based on the doctrine of priority of use, are considered fully adequate by both users and administration. A comprehensive study of the state's water resources has been under way for two years, covering all phases of shortages, surpluses, irrigable areas, methods of conservation, transmountain diversion and related matters.

Utah—Irrigation Expansion Slows up and State's Coal Is Studied for Power

By GEORGE M. BACON, *State Engineer*

WATER DEVELOPMENT in Utah, for both irrigation and power, is rather stationary at the present time. The 1,325,000 acres of land now under irrigation is believed to be fully adequate for present needs, and general opinion favors confining immediate expansion to making more adequate the water supplies for land now under irrigation, rather than bringing in new land. In this connection the state has cooperated actively with the U. S. Bureau of Reclamation, which completed the Echo Reservoir during the past summer to furnish 74,000 acre-ft. of storage to land in Weber and Davis counties that now has only a partial supply.

Hydro-electric power is 14 per cent developed, but the output is adequate for present needs. Only the smaller streams have been utilized for power so far. The large-scale developments available on the Colorado River are complicated at the present time by the condition of the agreement between the upper basin states. Meanwhile, increasing consideration is being directed toward the utilization of the states' extensive coal deposits for the generation of power by steam.

The Utah water storage commission, created by legislative act "to make investigations looking to a full and proper development and utilization of the state's water supply," has been functioning actively for seven years and has accumulated a general knowledge of possible water development throughout the state. The present water code, which recognizes only the rights acquired by appropriation, is believed to be wholly adequate for present needs, except in application to underground supplies that do not flow in known or defined channels.

Wyoming—Future Water Developments Will Be Made in Larger Units

By JOHN A. WHITING, *State Engineer*

EARLIER water-development projects utilized the smaller and more accessible supplies. Future development in Wyoming will therefore necessarily be in larger units, and at increased unit cost. Irrigation has expanded gradually to the present area of about 2,000,000 acres, with no outstanding increase in development for any one year. Attempts are being made to coordinate development with colonization.

Hydro-electric power demands in the state are rather small, because of lack of markets. Industrial development is not large, and distances for transmission between centers are so long that development is slow. At present about 17,500 hp. is developed in the state, or 4 per cent of the estimated available minimum of 400,000 hp.

The Wyoming water code is based exclusively on the doctrine of appropriation. It is considered adequate for present needs, with occasional minor changes, particularly as regards the requirements of administration.

Western Water Development

Based on fifteen years' study of its water-supply resources by the state in cooperation with the U. S. Geological Survey, it is estimated that the total water available is about 10,000,000 acre-ft. per annum. Of this amount 3,000,000 acre-ft. is now applied to beneficial use.

New Mexico—Future Developments Will Require Extensive Storage

By HERBERT W. YEO, *State Engineer*

A CONSIDERABLE PROPORTION of the 538,000 acres of land now under irrigation in New Mexico had been developed in a crude way prior to the arrival of the Spaniards in 1540. There remains approximately 500,000 acres of irrigable land for which water is available if a satisfactory allocation of the San Juan River flow is effected under the proposed compact of the upper basin states. The unappropriated waters of the state, confined principally to the San Juan and Canadian rivers, are largely floodwaters and can be utilized only in connection with extensive storage facilities. This supply is estimated at 2,500,000 acre-ft. of unappropriated surface water, depending upon the final allocation of interstate streams.

The present water code, based exclusively on the doctrine of prior appropriation, is not adequate. Some changes are desirable to correct antiquated and inoperative laws. A new code, drafted in this office, probably will be submitted to the state legislature this year. In the investigation of water resources for future development, emphasis has been placed on underground sources, and certain laws of the state pertaining to underground waters are outstanding on this subject.

Arizona—Irrigated Acreage Is Enlarged Despite Subnormal Rainfall

By FRANK P. TROTT, *State Water Commissioner*

PROSPECTS for 1931 indicate a continued gradual development of water resources in the state. Present applications for hydro-electric developments total 600,000 hp., but probably not all of these applications will be approved. Many of the possible power sites are still unsurveyed. The existing development can be estimated (only approximately) at 20 per cent of the total available. This calculation does not take into consideration the power possibilities on the Colorado River.

Although the past few years have been a period of unusually subnormal precipitation, which has affected the 550,000 acres of irrigated land, development is continuing. An estimate of the remaining irrigable and susceptible of economic irrigation is not possible until further surveys and soil tests have been made. The state water code, based on the right of appropriation, is considered adequate, with possible minor modifications to give more specific authority to the enforcement of the code. No definite comprehensive program for studying the development of the state's water supply as a whole has ever been undertaken.

Problems in Concrete Dam Design

Progressive thoughts are centered on uplift, prevention of cracks and heat control—Cement specifications for mass concrete need revision—Precast block construction offers distinct advantages

By D. C. HENNY
Consulting Engineer, Portland, Ore.

THE SAFE and economical design of concrete dams is engaging the concentrated attention of a large number of engineers, as evidenced by the array of articles and discussions on dam design published within the last few years. Curiously, the differences of opinion have developed not so much on the mathematical processes employed (although even here unanimity is lacking) as on the fundamentals—upon which it would seem easier to agree.

What are these differences of opinion? Perhaps a typical one is the lack of agreement on the permissible unit stress in the concrete. The allowable maximum stress in compression has been gradually advanced from 16 to 45 tons per square foot, the latter being a usual limit in recently built arch dams, and for the Hoover Dam, the limit has been set at 30 tons. Since concrete made with good aggregate and 1 bbl. of cement per cubic yard shows a strength of 200 tons per square foot after 60 days and additional strength can be had by increasing the cement content, even the highest of these working limits seems conservative in regard to loading of concrete on concrete. Concrete load on foundation is another question, but if the foundation rock is weak the load can generally be spread, and the limit of foundation load need not affect the loading within the structure.

Such an example of variance in engineering opinion indicates the divergence that will affect design practice until certain fundamental principles are established as underlying the science of dam building. Further advancement in the art must be handicapped until this is accomplished. To indicate the present status of some essential questions that need continued study looking toward a better agreement of opinion, the major controversial points in concrete dam design are outlined in the following.

Uplift and Its Factors

History—Outstanding among subjects of controversy in dam design has been the allowance to be made for uplift—a factor that was ignored until 1884. Many

gravity dams have been designed and built without any consideration having been given to uplift, and, with two exceptions, all have stood the test of time well.

The Bouzey dam, in France, failed in part because its dimensions were inadequate, even ignoring uplift, and in part because it had a bad foundation. The Habra dam in Algiers was constructed of defective masonry. In the report on the failure of the latter structure the following statement occurs: "In the construction of such a wall we can follow all the laws depending upon its static conditions and the pressure of water, which can be determined with certainty." Such satisfying assurance as to the characteristics of water pressures, given at a time when the 78-ft. Boyd's Corners dam (1870) in New York and the 184-ft. Furens dam (1866) in France were the highest masonry dams in existence, would not be repeated by any present-day board of investigation.

In the design of the 260-ft. New Croton dam (1892-06) uplift was ignored not because the engineers were unaware of its possible occurrence and general effect, but because the great depth of rock excavation and the care taken in sealing rock fissures were believed to be effective in confining it to a relatively small area. Since about 1895 the subject has received consideration both here and abroad, although it was not until ten years later that provision for uplift forces was first taken into account in this country in the design of the Wachusett dam.

Since that time engineers have discussed the question of the amount of uplift force which should be assumed in design, at first on the basis of speculative reasoning and later with the aid of experimental data.

Uplift

Grouting along the upstream toe of a dam does not guarantee against uplift . . . its effect is usually a diminution of foundation uplift.

Drains

The important requirement that drains be straight and accessible for cleaning is too often neglected.

Cracks

Possibly the principal cause for this more extensive cracking may be the tendency of cement manufacturers to increase the fineness of grinding and thus increasing heating.

Heat Stresses

Measurements have given ample evidence of the existence of thermal stresses far greater than any pure loading stress. The problem of heat stresses and cracking can be solved with greatest certainty by using precast concrete blocks.

Effect—The potential danger of uplift is cumulative in that it reduces loading at the heel, thereby facilitating entrance of water. Its effect upon sliding factor has been the direct cause of several dam failures.

The attention given to this question by engineers has been directed both to the porosity of mass concrete and to the imperfect adherence at joints. The joint at the base naturally has received greatest attention, because water can reach any part of the base through rock seams in the foundation and because the difference between foundation rock and concrete tends to reduce adhesion. Referring to conditions at the water face, the ratio between vertical loading and water pressure is usually most unfavorable at the heel, and horizontal shear is greatest. These conditions favor the entrance and creep of water, which may exert full uplift pressure over a limited area or a gradually reducing uplift pressure over parts of the entire base.

The danger inherent in uplift is now thoroughly realized by dam designers and builders, and they have developed various means of reducing its effect. Chronologically arranged, these consist of: (1) roughening rock base and concrete surfaces to increase adhesion and resistance to water creep and to sliding; (2) grouting the foundation; (3) introducing drains in the foundation and the mass concrete; (4) inclining or stepping the construction joints upwards in a downstream direction; and (5) using water stops in the joints near the water face.

Grouting—Foundation grouting has become common practice in the construction of concrete dams since the building of the New Croton dam, where it was used mostly to fill cavities in the limestone. When the rock foundation is hard and reasonably free from seams, grouting is usually confined to a vertical zone under the upstream toe for depths often less than 20 per cent of the dam's height. If the rock is very seamy or shattered over small areas the grouting may go deeper and extend over the entire foundation.

Diamond-drill holes in grouted areas have shown, time and again, the effectiveness of this process in curing defects in the rock both as to strength and tightness, provided the rock seams are clear of obstructions. Where seams are filled with clay, grouting cannot enter and thus restore shearing strength; and where they are filled with sand neither shearing strength nor tightness can be secured, for grout cannot be made to penetrate even under high pressure.

Grouting along the upstream toe of a dam does not guarantee against uplift under its base. Seaminess of the foundation rock may extend to an indefinite depth, and water may move below the termination of any grout curtain which may be provided. Grouting rarely effects complete closure, but usually nothing more than a diminution of foundation uplift is measured at the base of the dam.

Drains—Vertical drain holes in the foundation rock and in the concrete, generally located a short distance downstream from the water face and connected to galleries, are now common features of design. However, the important requirement that these drains be straight and accessible for periodic cleaning is too often neglected.

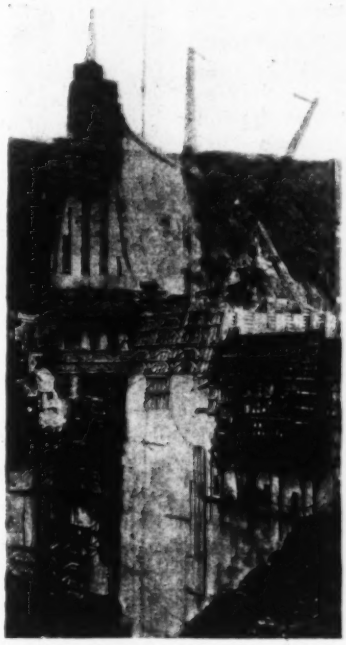
The effect of these drains in reducing uplift has been studied from results obtained by actual measurements of uplift pressure. The method consists of burying gravel bags in the concrete at selected points on the foundation, with pipes leading to the drainage gallery for the measurement of pressure. Figures are available from a number of dams in the United States and Germany that are founded on rock, and also from some low dams resting on sand and gravel. Considering only the former examples, there is but one case on record (the Oester dam, Germany) where the plotted pressures show an uplift that exceeds a straight water gradient connecting reservoir water pressure at the heel with backwater pressure at the toe. On such diagrammatic representations of uplift the effect of drainage is universally very marked, yet even in the most favorable case pressure has been observed at some points of the foundation downstream of the drains.

Intensity of Pressure—Uplift pressure measurements along concrete joints are at present available for two

dams. At Bull Run only five of the twelve pressure points installed at various elevations showed any seepage pressure. At four points this pressure head varied from 3 to 8 ft. above the joints, as compared with a reservoir head of 140 to 160 ft. The other point, 4.5 ft. from the water face, showed a pressure head of 35 ft., compared to a reservoir head of 161 ft. It is interesting to note that the concrete joint pressure gradient is occasionally found to be unaffected by the concrete drains, even though many of these drains show dripping moisture. At the Gibson dam 32 uplift points were installed at various elevations. Two of these showed pressure of less than 1 ft., two others had evidence of moisture, and the other 28 points were dry.

The data available for dams on gravel and sand base indicate a gradually diminishing uplift pressure, greatly affected by local conditions, especially by deep cutoffs.

The trend is toward more deliberate and intelligent care in preparing the foundation, by providing a cutoff trench, by grouting (not only a cutoff screen but wherever rock is unusually seamy over extended areas), by special care in roughening the contact faces and securing the best bond between base and concrete, and by closer concrete control to insure watertightness. In some recent dams steel plates have been used as water stops close to the water face at horizontal construction joints. These are usually 6 in. wide and are forced for half their width into the finished pour. Preparation of the surface of old concrete by wire brushing, high-pressure air and water jets, horizontal drains and keyways, and the use of thick cement grout ahead of each pour also are receiving increased attention.



Definite provision is now made for contraction and radial shear

Area of Uplift—Any consideration of uplift force involves the question of the area that is subjected to uplift pressure. The uncertainty as to this factor in the case of gravel and sand foundation is not great, for experiments have shown that the measured uplift force is from 82 to 98 per cent of the product of local area and pressure. In the case of rock foundation, however, no definite facts are known, and engineers' estimates have varied from 20 to 100 per cent of the area.

Limitations on Uplift Area

It has been argued that there is a definite minimum of uplift pressure area, because the concrete, not being absolutely watertight may be regarded as saturated from water face to air, and there must must be a gradually reducing pore pressure. It would follow that the absolute minimum should be the intensity of pore pressure applied to the maximum percentage of pore area occupied in a most unfavorable imaginary cut through the concrete. This area has been estimated at from 25 to 35 per cent of the total. However, in the usual case of a gravity dam designed on a dry-weight-of-concrete basis, it should not be overlooked that water penetration through the concrete mass increases its weight. Such weight increase neutralizes, to the extent of mass pore percentage, the supposed maximum percentage just mentioned and would reduce it to somewhere between 10 and 25 per cent.

Experimental efforts were made at Bull Run dam to measure the effective uplift areas by casting fresh concrete on old in test cylinders and introducing high water pressure at annular sand channel areas in the joint. By means of control cylinders adhesion tests were made, and the water pressure necessary to overcome adhesion was determined, assuming the pressure as effective only over the area of sand channels. The pressure so determined was found to be only slightly more than that required to break the test cylinders. Examination of broken samples showed that the red colored water used had stained only about 3 per cent of the adhesion area. These results were obtained where the surface of old concrete was not roughened in any way, cleaned or prepared. No experiments were made with concrete in contact with rock. Such results indicate that there is an unavoidable practical difference between the most careless laboratory work and the most painstaking field methods.

Practice in Calculating Uplift—The conclusion drawn by many engineers is that a 100 per cent area allowance is wise, and that this assumption covers a fair margin of ignorance. As to the pressure itself the experimental results demonstrate that thorough and accessible drainage permits the assumption of a break in the uplift pressure line, which may be on the basis of an estimated percentage of efficiency of drains. In some recent cases of dam design this has been figured at 75 per cent, thus reducing the pressure in the location of the drains to 25 per cent of the calculated straight-line pressure.

The Effect of Cracks

The design of masonry gravity and gravity-arch dams is based on the fundamental conception that while transverse contraction joints break up the structure into separate units, these units considered by themselves function as monoliths. It is taken for granted in all cases that the structural units are not fractured, and the design requires that shearing stresses are kept within safe limits.

Normal to Face—This basic conception seemed warranted by the success of earlier dams, where foundations, character of construction and the generally accepted design were adequate. It is true that transverse cracks were observed, but these could not be considered dangerous at least in gravity dams, as their direction was generally normal to the faces. They led, however, to the introduction of contraction joints with copper stops for tightness and keyways for tightness and radial shear.

For dams from 100 to 200 ft. or even more in height, this provision seemed to fill all requirements provided the spacing of joints was sufficiently close—first taken at 100 ft., but constantly trending toward reduced spac-

ing, until now from 40 to 50 ft. is common practice in dam design.

This gradual reduction of spacing was forced by the fact that cracks formed between these joints. In recent dams cracks have been observed when the joint distance was only 30 ft. One, and possibly the principal, cause for this more extensive cracking may be the tendency of cement manufacturers to increase the fineness of grinding. This practice affords certain advantages in workability, early strength and form cost, but in mass concrete the important effect is greater heating and consequently an increased liability to crack during cooling. This becomes aggravated by increased height and base width of dams and by the persistent tendency toward more rapid construction.

Parallel to Face—In large dams cracking is not confined to a direction normal to the faces but is apt to occur in a more dangerous direction—parallel to the faces. Such cracking, even when not continuous over long distances, reduces the shear resistance of the concrete in a direction where the shear is close to a maximum under full load. Should a crack extend through from the base to the downstream slope in any unit, that unit can no longer act as a monolith; in this event, because of tension at the heel and increased loading at the base just upstream from the crack, the limits of safe loading and sliding resistance may be greatly exceeded in an otherwise conservatively proportioned dam.

Cracks parallel to the water face can only be detected in cross galleries. They may be present on an extensive scale in some existing dams without any practicable means of discovering them. Such cracks have been observed in the heavy buttresses of buttress dams, an observation that should make the engineer cautious when dealing with permissible rate of construction in his specifications, and should induce him to consider special means of reducing heat development in massive work.

Heat Control by Cement Quality

Means of heat control may consist, in the first place, of amending cement specifications to keep heat generation within lowest practicable limits. A heat rise of 50 deg. F. in the center of a dam is not uncommon, and in one dam a rise of 68 to 70 deg. F. was observed, although the work was not unusually massive.

Research work is necessary to determine what changes should be made in the specifications for cement to meet this particular requirement and to induce manufacturers to comply with these revised specifications at no greatly increased cost.

The profession and the cement industry have cooperated in bringing about the appointment, by the American Concrete Institute, of a mixed committee of cement experts and engineers to study stresses in mass concrete. This committee is now at work on this problem. The comprehensive scheme of research which it has outlined should be started at an early date, by cooperation of all interested agencies, governmental and private.

The problem is not merely one of avoiding cracks in massive work. Experiments indicate that concrete cured under conditions of increased heat does not attain the strength of test cylinders cured under laboratory conditions. Telemeter measurements in dams, while disappointing in not yielding the definite information hoped for, have given, nevertheless, ample evidence of the existence of thermal stresses far greater than any pure loading stress. Quoting from a recent report on the problem of stresses due to shrinkage: "The problem of shrinkage stresses is farther from a final solution than is the problem of stresses due to load."

One means of avoiding cracks parallel to the water face is the introduction of contraction joints parallel to that face and located along lines of principal stress under load. In a gravity dam they would extend only partly through the mass, so as to end at a safe distance from the water face, where their direction would tend toward the horizontal. They would have to be thoroughly drained to prevent accumulation of seepage water pressure. But the experience with buttresses where such joints were introduced makes it questionable whether they would be altogether effective in dams of a height and mass far beyond past precedent.

Artificial Cooling

In one dam now nearing completion (Ariel, Wash.) experimental 10-in. vertical water-circulation holes have been introduced, and their influence on concrete temperature is being closely watched. The short-time results so far obtained are very promising.

A similar water-cooling method is specified for the Hoover Dam (see *Engineering News-Record*, Dec. 25, 1930, p. 1,011), where 2-in. horizontal circulation pipes (later revised to 3-in. diameter) and a large refrigerating plant for cooling the water are to be used. The dam is to consist of interlocking 50x50-ft. columns, with joints which will be grouted after cooling.

Precast-Block Construction

The problem of heat stresses and cracking in dams can be solved with greatest certainty by using precast concrete blocks. These blocks might be of such moderate size that they would not be subject to cracking, even with the use of the present finest-ground commercial cement, and of a weight that would leave it within the power of heavy derricks or cableways to handle them with ease and accuracy. They could be cast long before use, stored under canvas and cooled to a temperature well below annual average by moistening and air blasting for some time before going into the structure. They could be laid in the dam on horizontal mortar beds, while vertical joints could be made wide enough to take up slight inaccuracies and to permit the use of fine-aggregate concrete for joint filling. Both horizontal and vertical joints could be broken according to a system which takes cognizance of the direction of principal forces, develops maximum mass shear and requires a minimum of different sizes.

In dam construction the precast-block method has also the advantage of permitting and maintaining a steady predetermined rate of cement, sand and gravel handling, thus cutting down the needs of storage. Moreover, it would reduce the cost of formwork, do away with the need of subsequent joint grouting, and place no limit on the rate at which the dam construction work may be brought up. It remains to be seen to what extent these economic advantages may be offset by the necessity of double handling and the cost of making mortar and concrete joints.

The highest dams now contemplated are of the gravity-arch and arch types. The theoretical treatment of design has slowly advanced, but with every step forward there has come more elaborate mathematical calculation. Shortcuts and mechanical aids have been devised to

simplify the work, yet in spite of these the process remains cumbersome, slow and expensive.

Western Water Development

The calculations must be based on assumptions regarding the qualities of the concrete, which can be but imperfectly known even when concrete is mixed, deposited and cured under ideal conditions; hence it may seem that refined mathematical calculations are not justified. This impression may be strengthened by noting that in practice it is impossible to attain the perfection of execution assumed in the design.

However, the detailed control of fieldwork is steadily advancing, in part because engineers have entered the field of contracting to a greater extent than was formerly the case, which makes for more intelligent cooperation between the forces of design and construction. In concrete work this may be indicated by the voluntary introduction of weighing rather than measuring devices, and the exercise of greater care by the contractor in many details independent of inspection. While neither design nor method of production is perfect, it cannot be said that the one is seriously lagging behind the other, and even if this for the moment were to be the case, it would be unwise to retard progress in any direction in attempting to keep a balance.

Progress must be based on research, and it is an encouraging sign that municipalities and companies are willing to authorize expenditures in that direction, that existing technical societies and associations are doing their part by forming committees of investigation, and that men can be found who are willing to give generously of their time to serve on such committees for the purpose of advancing engineering knowledge.

Ariel Dam—

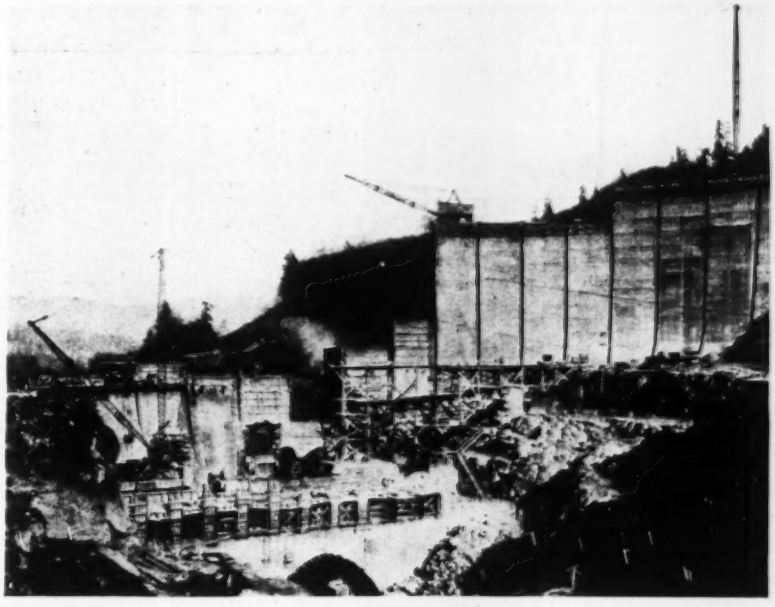
An Example of Modern Dam-Construction Practice

Final location based on 26,000 ft. of drill-hole exploration—Foundation excavated 125 ft. below streambed in brief low-flow season

A SITE considered so difficult that 26,000 ft. of drill hole was put down to explore it, a foundation excavated 125 ft. through gravel to bedrock, and careful concrete control are among the features that distinguish the Ariel Dam of the Inland Power and Light Co. on the Lewis River in Washington, about 40 miles northwest of Portland, Ore. Because of these striking characteristics it is an excellent example of difficult dam building of modern times.

The 313-ft. structure of thin-arch type with one gravity abutment has a total crest length of 1,300 ft. and will provide a head of about 200 ft. for the power plant located at the base of the dam. Stream regulation provided by the 220,000-acre-ft. reservoir will be supplemented later by additional storage upstream in carrying out an ultimate program to provide complete stream regulation and a total power output of approximately 4 billion kw.-hr. Ariel Dam contains about 300,000 cu.yd. of concrete, including 95,000 cu.yd. in the gravity section.

Above the Ariel site the Lewis River drains 750 square miles, with headwaters in the Cascade Range at El. 7,500. The maximum flood of record is 63,000 sec.-ft., while the average flow of the river varies from a minimum of 800 sec.-ft. to a maximum of about 30,000 sec.-ft.



The dam is concreted in 30-ft. blocks separated by 2-ft. slots. The power house rests on an arch, which eliminated the necessity for a deep foundation

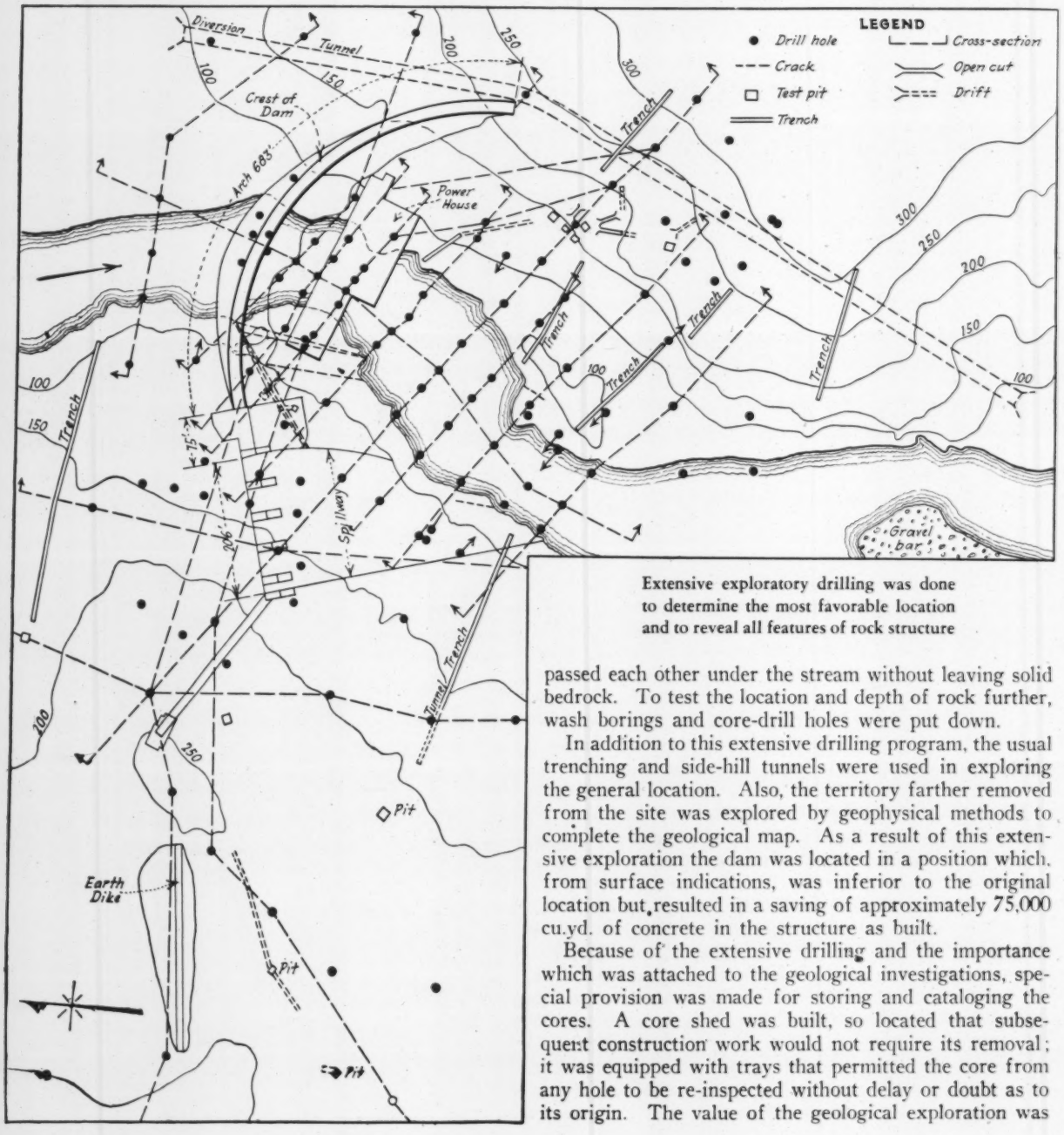
[*Western Water Development*]

The average annual runoff is approximately 4,000,000 acre-ft. The contemplated program for the development of the river will provide for equalizing this flow.

Geologically, the site represents an ancient box canyon that included a waterfall at the location of the dam. Subsequent to the erosion of the canyon by the stream, its elevation with respect to sea level changed, and the bottom of the ancient waterfall is now 73 ft. below sea level. The change resulted in depositing river sand and gravel to a depth of almost 125 ft. The rock is hard and strong, being classed geologically as basalt and andesitic lavas.

Exploratory Work—After tentative selection of the site the geological conditions were recognized as so complex as to justify exceptionally extensive exploration. The investigations actually cost about $150,000. This exploration program was also dictated by desire to combine utmost safety with greatest economy through selecting the best location. Drill holes were put down along lines 100 ft. apart at right angles to the river yielding geological cross-sections of the canyon both upstream and downstream of the preliminary site. With the development of these geological data the site originally selected as best, from the study of visible factors, appeared inferior to an upstream location, and accordingly the structure's position was moved 125 ft. upstream.

From earliest investigations of the site it was evident that a great depth of loose material would be found in the streambed overlying the bedrock. When the final location of the dam had been decided, oblique drill holes were put down from both abutments, inclined toward the stream, and these were continued until they



Extensive exploratory drilling was done to determine the most favorable location and to reveal all features of rock structure

passed each other under the stream without leaving solid bedrock. To test the location and depth of rock further, wash borings and core-drill holes were put down.

In addition to this extensive drilling program, the usual trenching and side-hill tunnels were used in exploring the general location. Also, the territory farther removed from the site was explored by geophysical methods to complete the geological map. As a result of this extensive exploration the dam was located in a position which, from surface indications, was inferior to the original location but resulted in a saving of approximately 75,000 cu.yd. of concrete in the structure as built.

Because of the extensive drilling and the importance which was attached to the geological investigations, special provision was made for storing and cataloging the cores. A core shed was built, so located that subsequent construction work would not require its removal; it was equipped with trays that permitted the core from any hole to be re-inspected without delay or doubt as to its origin. The value of the geological exploration was

believed to have been aided materially by this care in making the results accessible for reference.

Diversion—Upstream and downstream cofferdams were constructed of rock-filled cribs faced with steel sheetpiling driven 30 ft. into the gravel on the river face. A diversion tunnel 25x25 ft. in cross-section after lining was driven under the east abutment for a length of 1,460 ft.; its capacity is 15,000 sec.-ft. with full head on the upstream cofferdam.

This diversion scheme, which was as large in capacity as was economically justified, permitted only a three-month construction period for foundation work free from flood hazard. During this short period it was essential that excavation work be carried to bedrock and approximately 46,000 cu.yd. of concrete be placed to bring the structure up to streambed elevation. Following construction of the dam the tunnel will be plugged with concrete.

Excavation was started in the river during the summer of 1930, although considerable work had been done previously at both ends of the structure. It was carried down through 125 ft. of gravel by power shovels and trucks, supplemented later by hand-loaded skips, to an elevation 74 ft. below sea level. At this depth the canyon was 55 ft. wide and terminated in hard rock pitted by large potholes that still retained granite boulders left by the ancient waterfall. Seepage was high, and electric pumps suspended from cables handled as high as 20,000 gal. per min. at the deepest point. In this narrow central gorge alone 190,000 cu.yd. of gravel was removed, and 46,000 cu.yd. of concrete was placed in four months without interruption.

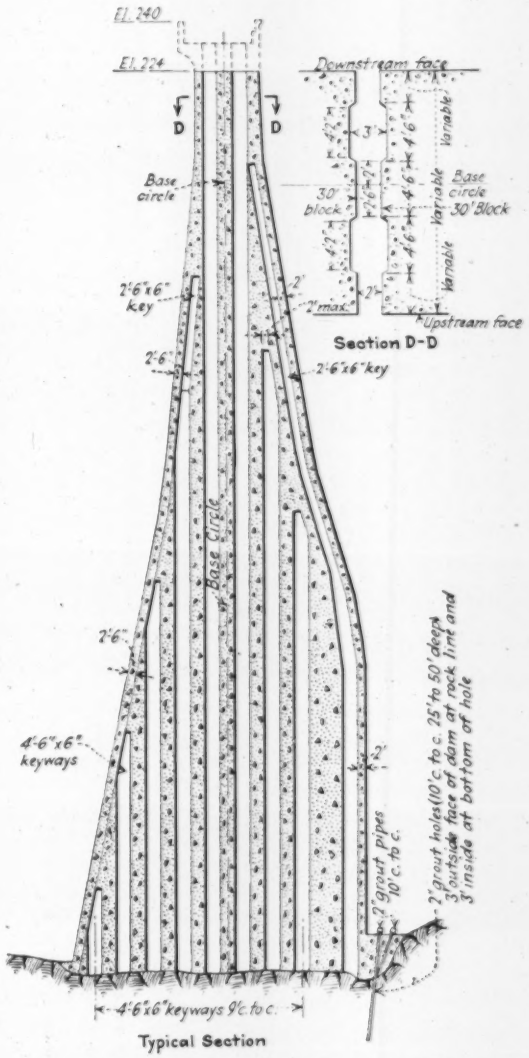
Design and Plant—The location proved economical for the adoption of a thin-arch design, except that the west abutment required an artificial thrust block. This gravity abutment, which has a maximum height of 160 ft. and a length of about 300 ft., will carry four tainter gates 39 ft. long by 30 ft. high and one 10 ft. long by 30 ft. high, having a combined capacity of 120,000 sec.-ft., or double the maximum flood of record. The spillway will include a concrete apron to carry the discharge to the river.

The arch was designed by the trial-load method, using a 600-lb. maximum stress. Subsequently, the arch calculations were checked at the Denver office of the U. S. Bureau of Reclamation, where the trial-load method was developed.

The concrete plant uses sand and aggregate excavated, washed and graded at the site, and bulk cement hauled 12 miles in specially built tank trucks from Woodland, Wash. The aggregate is graded $\frac{1}{4}$ to $1\frac{1}{4}$ in. and $1\frac{1}{4}$ to 3 in. Proportioning is done by weight, the mix being approximately 1 to 10 (1 : 3.4 : 6.6). The water-cement ratio was originally fixed at 1.00, but was later reduced to 0.97 because of the easy workability of the aggregate. Water control is governed—for practical purposes—by inspection of the concrete as it arrives on the job, but check testing of grading and moisture content is carried on continuously. The resulting concrete has an average strength of 2,600 lb. at 28 days.

The time of mixing is $2\frac{1}{2}$ min. in the three 2-yd. mixers. The concrete is discharged into 2-yd. bottom-dump buckets delivered in one- or two-car trains by gasoline locomotives to the dam, where derricks and revolving cranes lift them into position for dumping by the concrete crew. Placing is done in 12-in. layers in lifts 5 ft. high in the gravity section and 10 ft. in the arch. The concrete is vibrated as placed by means of a steel shoe carrying a small portable gasoline engine which has had its flywheel placed slightly off center.

Special efforts were made to synchronize placing operations in the center section because of the necessity for speed in bringing the structure up to streambed level. Concreting was carried on in two ten-hour shifts, and placement was at the average rate of 1.7 cu.yd. per minute during the night and 1.6 cu.yd. per minute during the day.



Arch section showing keyways and slot

Heat Control—To reduce heat generation and resultant shrinkage stresses, the arched section of the dam is being built in sections 30 ft. long separated by 2-ft. spaces, which will be filled six months after the pouring of the main section is completed. Thus, for a section of arch where the thickness is 30 ft. the radiation from the central point is in four directions instead of two, as in the case of ordinary arch construction. Studies are being carried on with electric thermometers to determine the additional radiation permitted by these open sections. Preliminary results indicate that the arrangement is proving most successful.

Vertical pipes with circulating water were placed in several blocks to determine the effect this arrangement would have on the rate of cooling. Resistance themometers placed in these and in adjacent blocks without water circulation permit comparative temperature curves to be plotted. Preliminary results indicate that there is much more rapid cooling in blocks provided with circulating water than in solid blocks. The temperature of concrete when placed averages 60 deg. F.; later the temperature rises to a maximum of 130 to 140 deg.

[*Western Water Development*]

Organization—The Ariel Dam is being built by the Phoenix Utility Co., for the Inland Power & Light Co., of Portland, Ore. Upon completion it will be leased to the Northwestern Electric Co. L. T. Merwin is vice-president and general manager of the Northwestern Electric Co.; H. F. Lincoln is construction manager on the project for the Phoenix Utility Co.; Lyman Griswold, Portland, is consulting engineer for the local company; and D. C. Henny, Portland, is consulting engineer for the state of Washington.

Developments in Western Municipal Water-Supply Practice

By HARRY N. JENKS
Consulting Sanitary Engineer, Berkeley, Calif.

Increasing recognition of sanitary engineering principles emphasizes economic factors of water supply—Improvements in treatment make local supplies available and afford means of correcting quality—Degeneration of mountain supplies

THE DIVERSITY of climatic and topographic conditions in the Western states produces a corresponding variety of water-supply sources and possible methods of development for municipal use. The most important sources are the surface streams of the Rocky Mountains and Pacific Coast areas. Through the development of these sources some of the most spectacular engineering achievements in American water-supply history have been recorded; although, in the light of subsequent experience and the advantages of modern purification practice, it appears that some of these projects lack full economic justification.

Recently Western municipalities have been passing through a transition period familiar to leading cities in the East at least twenty years ago. The esthetic value of mountain water as such now is being weighed against the cash value of cheap water. It will be the continued task of the sanitary engineer to place the future development of municipal water supplies in this region on an economic basis consistent with water of highest quality. In seeking additional or new sources of supply, primary consideration now is directed toward supplies which are close to the point of use, with purification by rapid sand filtration or other treatment as an integral part of the project. Consideration of existing water supplies from distant mountain watersheds leads to the conclusion that it may be less expensive and more reliable to filter this water than to provide the increasingly elaborate watershed protection now demanded and for the purpose of excluding objectionable tastes and turbidity.

Water resources in the Western states are increasing in value and are essential for such vital uses as irrigation and power, in addition to the primary requirements for domestic purposes. A dependable water supply rarely can be obtained from unregulated streamflow, and, hence, storage is an essential factor for any quantitative supply. This necessity for large impounding reservoirs and the long pipe lines required to convey this supply to the community served have made the purveying of municipal water in Western states comparatively expensive.

The storage of water at the source, in addition, often results in serious seasonal impairment of quality as to tastes, odors and turbidity, resulting from the excessive growth of microscopic organisms. Such situations are in direct contrast to the benefits naturally expected from prolonged storage of surface water. This phenomenon results chiefly from factors of temperature and sunlight, which in this region are especially favorable to the development of algae and allied organic growths. In an area of nearly 1,200,000 square miles with extremely diversified characteristics, it is impossible to generalize too extensively, but either from natural or artificial causes, practically all mountain sources are becoming less desirable as to quality with the continued development of the region. Difficulties encountered differ in degree rather than in kind. To meet the situation, it is obviously important to perfect the sanitary engineering design of, what one may term, taste-and-odor-removal plants, as a substitute for the conventional rapid sand filter installations.

Time was when it was considered improper, if not impolite, to suggest to city officials or the public that mountain water might need filtration, or at least chlorination, coupled with aeration or other means of combating organic tastes and odors and of safeguarding the sanitary quality of the supply. In recent years the water from practically every source, even under apparently ideal conditions of mountain catchment area, has been subjected to some form of treatment. This gives evidence of an evolution in the municipal water-supply situation. An outstanding exception to this general rule is the supply of Portland, Ore. That city takes justifiable pride in the quality of its water, and, incidentally, it is one of the cheapest supplies on the Pacific Coast. Other communities, however, have sought to emulate Portland without having the same natural advantages.

Western Water Development

Even at the present time there is reluctance in accepting a municipal water supply according to its quality as delivered to the consumer, instead of regarding it with prejudice because of possible inferior source. Mountain supplies have been considered to possess intrinsic value in municipal advertising. However, the public is gradually realizing that the problem of how much pure water should cost is the important factor in municipal expansion.

The need for counteracting the tendency of deterioration in untreated supplies and the increasing economic value of removing undesirable mineral constituents is accelerating the trend toward filtration and water-softening, in relation to many of the existing and potential water supplies in the Western states. As examples, it is probably true that the most satisfactory utilization of a near-by supply, such as the Pueblo, Colo., can best be accomplished through complete treatment, while the supply of Salt Lake City might be soltened with desirable results.

A typical mountain source of supply

In the development of water supplies for the Pacific Northwest, the matter of quantity has been stressed heretofore with the possible neglect of considerations relating to chemical and physical characteristics as they might affect industrial processes. A supply free from iron, clear and colorless, and devoid of microscopic organisms, such as is required for the manufacture of the best grade of paper pulp, is normally obtainable only through treatment. Consequently, some of the largest filter installations of the Pacific Northwest have been made at industrial plants.

In California the most striking new development in the utilization of water-treatment principles is in the reclamation of water from municipal sewage and storm-water drainage. The economic value of this procedure arises from one of two situations: (1) a deficiency in quantity, regardless of cost, may demand water reclamation as an auxiliary source of supply to meet quantitative requirements; or (2) excessive costs of the existing supply, regardless of its quantity, may suggest water reclamation as a means of producing an inexpensive supply for certain specific uses.

The general water shortage of southern California represents an example of the first situation, and extensive studies are now under way to consider utilization of sewage flow, after thorough purification, as a means of augmenting the depleted groundwater resources and, possibly, for direct irrigation of adjacent land. Esthetically this procedure may be considered as extreme, but, in reality, it is merely a scientific adaptation of sewage farming and appears to be a most logical development. The Grand Canyon National Park water-reclamation plant meets the condition of the second case, imposed by an extensive supply imported 100 miles by tank car. This plant, the first of its kind built for complete treatment of sewage to provide a water supply suitable for industrial purposes, was designed by H. B. Harmon, sanitary engineer, U. S. Public Health Service, and has been in successful operation since June, 1926.

Some of the salient characteristics of Western municipal water supplies and some comparative cost statistics are indicated in the accompanying table. According to accepted water-works practice, all these supplies are chlorinated. In all cases the supply from distant sources is delivered by gravity to the point of use. Filtration of near-by river supplies involves pumping costs, but the increased availability of dependable electric power at low rates, combined with improvement in pumping efficiency, has decreased the economic advantage of a gravity source of supply.

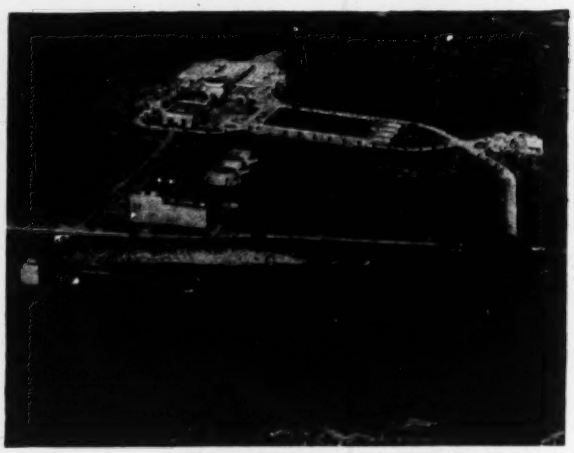
The extreme range of water costs for typical Western communities, as indicated in the table, is caused by many variable factors, including the unavoidable expense of

PHYSICAL CHARACTERISTICS AND COST DATA OF TYPICAL WESTERN MUNICIPAL WATER SUPPLIES

City	Population (1930)	Source	Type of Development	Conduit Length, Miles	Type of Treatment	Consumption — Annual Average, M.G.D.	Consumption — Average Daily per Cap.(b) Gal.	Costs Computed on Comparative Consumption Basis — Monthly Water Charge(d) Dollars	Meter Charge (¾ In.) Dollars	Total Cost per Month, Dollars	Corresponding Cost per 1,000 Gal. Dollars
Seattle, Wash.	425,000	Cedar River	Storage and river intake	26	Chlorination	60	141	1.90		1.90	0.09
Tacoma, Wash.	107,000	Green River	River intake	43	Chlorination	35	327	5.93	0.50	6.43	0.131
Portland, Ore.	302,000	Bull Run River	Storage	30	Chlorination	49	162	Flat rate		1.20(c)	0.049
Sacramento, Calif.	95,000	Sacramento River	River intake	0	Filtration(a)	25	264	Flat rate		2.77	0.07
Berkeley, Calif.	80,000	Mokelumne River	Storage	90	Filtration	5	65	3.30	0.55	3.85	0.394
Great Falls, Mont.	45,000	Missouri River	River intake	0	Filtration	5	111	4.50		4.50	0.27
Salt Lake City, Utah	145,000	Various Streams	Storage	20	Chlorination	22	152	1.67		1.67	0.073
Phoenix, Ariz.	60,000	Verde River	Infiltration	30	Chlorination	12	200	2.00	1.75	3.75	0.125
Denver, Colo.	330,000	South Platte River	Storage and river intake	60	Filtration	66	200	5.55	0.85	6.40	0.214
Pueblo, Colo.	25,000	Arkansas River	River intake	4	Clarification	10	400	9.00		9.00	0.15

(a) Filtration in every case includes chlorination.
(b) Average is based on m.g.d. divided by population without reference to industrial or other uses.
(c) Actual amount depends on character of lot and dwelling.
(d) At published rates.

developing supplies from distant sources and, in a few cases, particularly favorable conditions attendant upon the utilization of sources near the community. In making a comparison of the water charges, it should be mentioned that the cost per 1,000 gal. is based on the hypothetical use of the entire supply for domestic purposes. This appears to be the only practicable means of comparison on parallel conditions and, for the purpose of a comparative analysis, places the communities in question on a reasonably comparable basis.



Intake pier and filtration works at Sacramento—a notable Western example of this type of development

Many outside factors prevent any definite comparison between the cost of water and the domestic consumption thereof. However, it is reasonable to assume that the abnormally low consumption of the East Bay cities, of which Berkeley is typical, is a reflection of the cost of water which, in turn, reflects the cost of the water-supply project. This project cost the district, which comprises a population of about 500,000, approximately $60,000,000, including the acquisition of the local property. In addition to the estimated cost of domestic water at 39.4c. per 1,000 gal., the present district tax makes the actual cost in excess of 50c. per 1,000 gal. for valuable residential areas. It is of interest to note that an alternative project, proposed at the same time, for utilizing the floodwaters of the Sacramento River, could have been financed, according to an engineering report, through the difference between the two projects in respect to bond interest and retirement allowances alone. From the sanitary engineering standpoint this latter supply could have been made to afford a perfectly satisfactory quality as delivered to consumers.

In concluding, it may be said that a point has been reached where economic considerations are being given equal weight to those pertaining to engineering design. The source of supply formerly was considered of prime importance, whereas now it is the quality of water delivered to the user. This change in attitude places water purification in its proper relation to the problems of municipal water development. In turn, this situation indicates an appreciation of the fact that the sanitary engineer will come to a position in regard to municipal water supply corresponding to the status of the irrigation engineer in land reclamation and the hydraulic engineer in power development. The general acceptance of this principle will lead to the most economical production of water entirely acceptable to the consumer.

Army Engineers Oppose Construction of Barrier Against Salt Water in the Sacramento River

UNDER the provisions of the water resources survey act, the army engineers have recently completed and transmitted to Congress a partial report of the Sacramento, San Joaquin and Kern rivers in California. The survey was made principally to determine the advisability of federal participation in the construction of headwater reservoirs and in the building of a salt water barrier across the upper end of the bay from which the combined streams flow into San Francisco bay.

The barrier has been proposed to prevent the incursion of salt water into the delta regions of the river where there are extensive irrigation developments. Diversion of water above for irrigation purposes has so reduced the low-water flow that the salinity of the water in the delta region has been greatly increased. Col. Thomas Robins, the division engineer of the Southern Pacific Division, who supervised the survey, does not believe that the barrier is justified from an economic standpoint. The structure would cost $50,000,000 and would have no more effectiveness in salinity control than the headwater reservoir in the Sacramento. This adverse report is upheld by the Chief of Engineers.

Of the various reservoirs that have been suggested by state engineers, the only one recommended in the report as being of sufficient importance to navigation and flood control to justify federal aid is the Kennett reservoir on the headwaters of the Sacramento.

As it is realized that the economic feasibility of constructing the Kennett reservoir depends on the rate of interest money, Col. Robins recommended in his report that the entire project except the part of it relating to power development, be financed by the federal government with the understanding that the state would repay the greater part of the amount over a fifty year period. This is based on the supposition that the federal government can obtain money at a lower rate of interest than state governments. Exclusive of power development, the estimated cost of the project is $67,000,000. Neither the Board of Engineers for Rivers and Harbors nor the Chief of Engineers concur with this plan of financing.

In the final report by the Chief of Engineers, federal contribution toward the Kennett reservoir is limited to $6,000,000, which is recommended in the interest of navigation. The reservoir will have a storage capacity of 2,940,000 acre-ft. and it is believed can be operated so as to provide a dependable flow of 6,000 sec.-ft. in the Sacramento. By insuring this minimum flow in the river, serious incursion of salt water will be prevented.

Economic Aspects of Land Reclamation in Eastern Oregon

Excellent soil, adequate water supply and established communities are physical advantages — Markets for principal products are rapidly expanding—Expert opinion on financial soundness indicates terms can be met

By JAMES T. JARDINE
Director Oregon Agricultural Experiment Station, Corvallis, Ore.

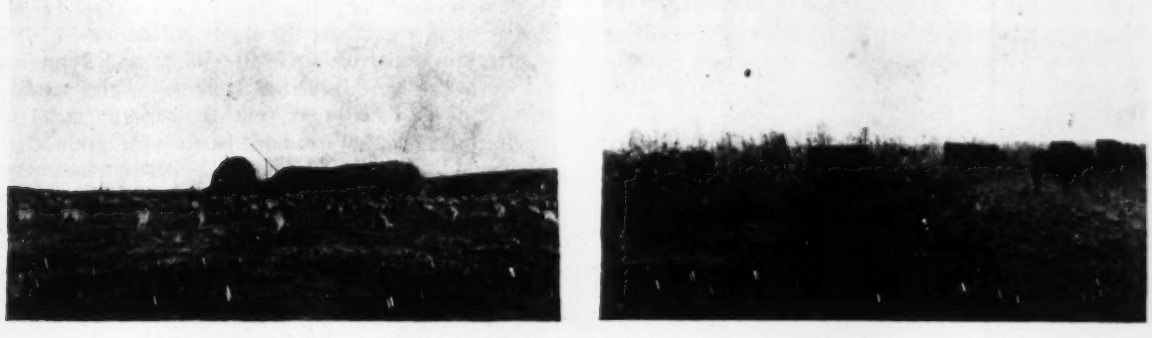
THE INCREASING IMPORTANCE of the economic factors affecting reclamation of arid lands and the more recent discussion of agricultural overproduction places more than usual interest on present irrigation development in eastern Oregon, where the U. S. Bureau of Reclamation is spending more than 20,000,000 on the Owyhee and Vale projects. These two large developments, the latter already coming into production, will place water on about 100,000 acres of raw land, in addition to assuring an adequate supply to approximately 57,000 acres already settled. Construction costs will be relatively high. Some of the economic phases influencing these developments, with particular reference to the marketing possibilities, are discussed in the following.

The degree of success to be predicted for any new irrigation project should be based on a study of the causes which led to difficulties in past developments. Such contributing causes in general are well understood, and the primary ones are merely listed: (1) Lack of soil and climatic conditions necessary to produce and continue to produce the quality and yield of products to make the development economically successful with changes in prices and market demand; (2) lack of water supply adequate for the area on which costs were estimated and construction undertaken; (3) unreasonable price for raw land of little value without water; (4) retaining of land for anticipated values rather than disposal of land on basis of production value with subsequent earlier development; (5) purchase of land and water at values beyond productive return, together with over-expansion and subsequent deflation. However, it should be noted that the concluding cause is common to all agricultural lands, and irrigation developments should not be judged without comparative statistics of hardships and failure by individuals and communities in other types of farming.

Physical Conditions—The soils within the final boundaries of the Owyhee and Vale projects rank high in quality suitable for irrigation agriculture, and when surveyed by experts and practical irrigators were classified as "among the best to be found in the Snake River Valley." Economy of production and relative chances of successful agriculture depend upon soils capable of sustaining high yields under practicable methods of management more than upon any other factor.

The adequacy of the water supply has been studied by competent engineers based on well-established flow records of the streams and the water-duty requirements used on the nearby Boise project, which operates under the same general conditions. From such study the water supply for the lands is deemed entirely sufficient and will relieve the projects of the need for meeting subsequent additional water-development costs or production under the handicap of an inadequate supply.

In accordance with the new policy of the Bureau of Reclamation, raw land on the projects has been appraised, and land owners have agreed to sell areas in excess of 160 acres for the appraised price, ranging from $5 to $15 per acre. Holdings of less than 160 acres, if sold for more than the appraised value, must have one-half the excess returned to the district and



Examples of live-stock feeding and conditioning (hay, feed and pasture) that will be important phases of the production program

[*Western Water Development*]

applied as credit on the construction charge against such land. This system of appraisal and sale assures the settler a fair price for the land without a speculative increment. Thus, to summarize, the lands on these projects appear to have soil of comparatively high quality, adequate water supplies and safeguards against payment for raw land above a conservative appraised value.

No Pioneering—The project lands are, in reality, extensions of agricultural areas already extensively developed and served by numerous towns, schools, market roads, highways and railroads. A large portion of the project lands is already being farmed, and on the Owyhee area alone there are some 600 farmers occupying about one-third of the project area. In many cases the new gravity water supply will replace and supplement present expensive supplies secured by pumping. Thus, the situation is entirely different from the development of a new section where years of expense and effort are required before these facilities become available.

Probable Crops—The advance economic surveys of the land concluded that approximately 60 to 65 per cent of the irrigated area should be devoted to alfalfa, clover, and pasture, with dairying, sheep, hogs and poultry enterprise recommended as proper supplements to these field crops. Such crops as wheat, corn and potatoes should, according to the recommendation, be produced, only in rotation with the hay products. Crop census data for identical lands in Idaho and Oregon indicate the suitability of this plan for land utilization, both as to production and farm organization.

Alfalfa will average 5 tons per acre

The seed is now an imported product, and the hay is badly needed to fatten Oregon lambs for marketing.

The land is situated at an elevation of between 2,200 and 2,500 ft.; the growing season is 140 to 160 days free from killing frosts. The section is climatically suitable for this type of development and is believed to form a productive area that will have no appreciable effect on the present surplus of agricultural products.

Marketing—Approximately 100,000 acres of new land will be brought under cultivation by these projects, but several years must elapse before production will extend over the entire area. In the meantime, it is logical to predict a considerable increase in population and market demand on the Pacific Coast for such products and by-products as will be produced on this new area when it has reached its capacity.

The population increase in the three Pacific Coast states from 1920 to 1930 was approximately 2,600,000, or 47 per cent. The increased consumption resulting from such a growth may be indicated by the case of dairy products; with an average per capita consumption of 1,000 lb. of milk per year in the form of all-milk products, 2,600,000 people require 346,666 cows, each producing 7,500 lb. of milk annually. The increased demand for other products should be of corresponding magnitude, and, although there can be no assumption that such market possibilities will be available primarily for these lands, there are already potential nearby markets with which the present development in this region has a growing trade.

The natural seed crops of this area, including clover, alfalfa and similar products, at the present time are imported into this country in large amounts. For the decade ending June, 1930, the average annual imports of red clover seed amounted to more than 10,300,000 lb. The average annual import of alsike clover seed during the last decade amounted to 7,300,000 lb., and approximately 1,400,000 lb. of white clover seed are imported annually. Recent importations of alfalfa seed range from 337,000 to 782,000 lb. annually. These lands already have demonstrated their suitability for the production of these crops, and they have been recommended in the major agricultural program.

Among the crops suggested for rotation purposes corn is recommended; in this connection it should be mentioned that approximately 2½ million bushels of this commodity are shipped annually into the Northwest from the territory east of the mountains. The Owyhee-Vale region is perhaps better suited to corn production than any other area of magnitude in the Northwest, and yields of 50 to 60 bushels an acre are not uncommon. The annual importation from the East represents the production of 50,000 acres at 50 bushels per acre, which can be accomplished on these lands. It would seem logical for this territory to produce corn for the needs of the region, thus saving the user the cost of transportation from eastern production points. It is most improbable that the production of corn as an incidental rotation crop would ever reach the proportions that would suggest any competition in eastern markets.

Probably the most valuable use for this new agricultural area is forage production in connection with the grazing of sheep in the adjacent range area. These irrigation projects are near one of the largest public range areas in the West; the sheep population in Idaho and Oregon is approximately 2¼ million and 2½ million head, respectively. Marketing studies for the state of Oregon indicate that 60 per cent of the farm lambs are sold off grade, and, with suitable pasture and grain, these lambs could bring from $1.85 to $4.14 per hundred more. Also, figures indicate that approximately 200,000 Oregon range lambs require further conditioning before they are suitable for advantageous marketing. According to feeding tests, approximately 20,000 tons of alfalfa and 10,000 tons of feed grain would be required to condition them. If these lambs were fattened in Oregon under present conditions, much of the grain used for this purpose would have to be brought from the Middle West at high

cost for long freight transportation, and it is evident that marketing outlets for the grain produced in the Owyhee-Vale territory need not be outside the region.

[*Western Water Development*]

Approximately 10 per cent of the hog receipts in the Portland market during 1930 were shipped from Eastern states, and approximately 32 per cent of the 253,452 hog receipts at South San Francisco originated as shipments east of the Rockies. Undoubtedly the shipments to the Los Angeles markets would show an even greater percentage originating in Eastern territory. These facts for 1930, together with the potential market increase on the Pacific Coast, would indicate a prospective market for any hog production that might take place in the Owyhee-Vale region. Approximately one-tenth acre of alfalfa pasture and 750-lb. of grain is required to market a 200-lb. pig. At this rate the probable increase in hog production from the Owyhee-Vale area would not supply even the 1930 shipments from distant Eastern states to the San Francisco and Portland markets alone. Assuming that new competition with more distant markets is undesirable, the new lands would still be entitled to an opportunity for prospective increased Pacific Coast demand, due to the local increase in population.

Ability to Pay Out—Will the settlers be able to pay out under the estimated cost of development, the physical conditions and marketing possibilities? Any answer might well be prefaced by the counter-question: What established agriculture *is* assured of success that warrants its designation as immune from probable economic hazards, or, for that matter, what business enterprise? The answer to the original question, in so far as it can be answered with any definiteness, must follow a line of reasoning similar to that briefly sketched above.

To summarize, the economic survey of the Owyhee-Vale projects—analyzed by the most eminent authorities and practical irrigators as to crops, yields, cost of production and sale values and based on the available facts, which appear to be sound—leads to the conclusion that the settlers can meet the repayment terms as set forth by the federal government. Looking beyond the soundness of our present knowledge, the regions and the land in question seem to have the soil, climate, assurance of water supply and other requirements, including general preliminary developments favorable for meeting such competition as may develop.

Plans for Sewage Reclamation in the Los Angeles Metropolitan Area

Overdraft is increasing deficiency of present supplies—
Rising water costs will make reclamation economical—
Exhaustive studies under way to determine basis of reuse

By R. F. GOUDEY
Sanitary Engineer, Department of Water and Power, Los Angeles

THE GREATEST concentration of population ever to assemble in a desert region is today building the Los Angeles metropolitan area. Already 2,500,000 people are living in a region representing only 1.4 per cent of the area of California and receiving less than 0.7 per cent of the state's water supply. One-third of the arable land, amounting to 2,200 square miles, has been put under cultivation, with the result that groundwater levels have dropped as much as 120 ft. in the past fifteen years. Man has never yet conquered the desert, and the present challenge is all the more tantalizing because so few of the people realize the seriousness of the rapidly dwindling water resources.

The city of Los Angeles alone has amply protected itself by imported water from outside sources. With the full development of the Owens Valley, Mono Basin and local sources, the city, with average years of rainfall, will be able to supply another 1,000,000 population. It is hoped that the supply from the Colorado River will be available before this margin is exhausted. However, outside the city the water situation is tragic.

Conditions Outlined

In an area of more than 165 square miles water is being pumped from below sea level, and several important supplies have become saline. Long before completion of the Colorado River aqueduct conditions will become critical. The rate of overdraft on underground water supplies now averages about 150 m.g.d.

Even with the importation of the Colorado River supply, which at first seems to be a large volume (1,500 sec.-ft.), the respite will be of short duration. It is predicted that by 1980 no water will be available for irrigation use. The quantity of water to be secured from the Colorado River was fixed by agreement and was not based on the actual future requirements of this area.

The seriousness of the water situation was realized several years ago by H. A. Van Norman, chief engineer and general manager of the department of water and power, who, with Dr. Carl Wilson, director of sanitation, initiated studies on the possibility of reclaiming sewage as an adjunct to water supply. During the past year these studies have been continued, until, today, those in charge believe that in reclamation there is available a reserve supply in the event that years of deficient rainfall continue or that there is undue delay in securing Colorado River water. The position of the outside communities is not so reassuring.

Wasted Into Ocean—In ten years population has increased 2.3 times, irrigation use has increased 50 per cent, and the volume of sewage discharged into the ocean has leaped nearly four times higher. Thus, it is not

strange that a daily overdraft of 150 m.g.d. is being recorded on the red side of the water-resource ledger. The table indicates also that the combined sewage flow from all outfall sewers into the ocean about equals the present rate of overdraft. In passing, it is interesting to note that this community, which should be the first to conserve, has wasted water most grossly. Having no streams into which to discharge sewage for reuse at cities below, this area has built some of the longest sewers in history. One completed trunkline is more than 26 miles long; another area has one 40 miles long, and a proposed system still being advocated would be nearly 50 miles in length. Although, from the standpoint of sewage disposal, long outfalls to the ocean are not justified, it has been the stimulus given to reclamation which is tending to revise the past policy of building long outfalls in favor of adequate treatment.

Increasing Water Costs—The consideration of what might happen before the Colorado River supply could be brought to this area prompted the original action of the department of water and power, but in reality it is the increasing cost of water compared to the cost of recovery which insures a program of reclamation. When orchardists got water from depths of 25 to 50 ft. it was considered cheap. In going deeper for water and in many cases pumping it for relatively long distances against high heads, the water costs have increased. Independent orchardists pay from 2.5 to 7.5c. per 1,000 gal. Owens Valley water delivered to the city costs 3c. per 1,000 gal. First-year cost of Colorado River water will be 15.8c. per 1,000 gal., and the average cost will be 9c. per 1,000 gal. delivered to the city limits. Undoubtedly the cost of this supply will stabilize water costs in general. Such costs are an inducement to reclaim sewage because it can be put on a paying basis.

Sewage as a Source of Water Supply

Paradoxical as it may seem, sewage, which is about 99.8 per cent water, is cheaper, safer and easier to reclaim than floodwaters and is more economical to develop than distant supplies. Colorado River water at Yuma is only 75 per cent water at times. Sewage does contain human body wastes in relatively minute quantities, but these can be removed by processes similar to those used by nature and are all the more positive in their action when placed under supervision and laboratory control. Sewage flow increases according to population with only slight variation in volume from day to day. Therefore, treatment works can function continuously and economically. In reclaiming floodwaters without storage it is necessary to provide works which function but a small fraction of the total time; and without clarification or purification the results are even more dangerous than those from partly treated sewage.

Except for one or two notable instances past attemps at reclamation provide no satisfactory precedent to indicate that conservation by this means is practicable. Ten years ago California was noted as the only place where sewage farms were successful. This impression was spread because several cities made profits in certain years. Over a period of years every sewage farm in the state, in addition to being a nuisance, has been operating "in the red." The tendency has been more and more to outlaw them in favor of high-grade treatment plants.

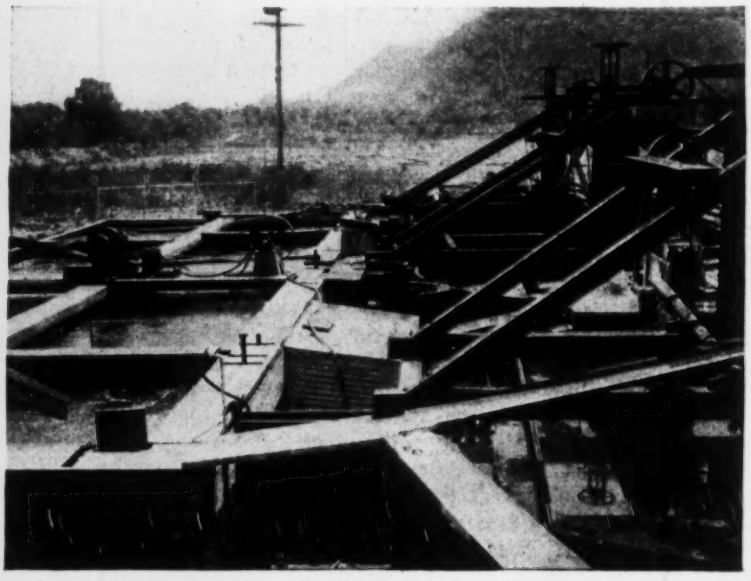
IMPORTANT WATER-SUPPLY STATISTICS
LOS ANGELES METROPOLITAN AREA

	1910	1920	1930
Population (round numbers)	540,000	1,000,000	2,300,000
Irrigated area, acres	200,000	300,000	400,000
Water consumed (total), m.g.d.	300	525	900
Water imported, m.g.d.	.....	100	200
Water overdraft by outside communities, m.g.d.	.....	.....	150
Sewage discharged into ocean, m.g.d.	17	37	143

Treatment for Reclamation—Sewage treatment as practiced in the past leaves much to be desired. In general, plants are designed by engineers who lack first-hand experience in operating practice; they are operated negligently and without adequate technical supervision; and both design and operation are based on a policy, apparently, of doing the least to "get by." Having assisted in planning and putting into operation more than 75 treatment plants, the writer makes the accusation that sewage disposal as now practiced is too inferior to take its place as the basis for definite reclamation programs.

Sewage reclamation takes sewage treatment out of the gutter and sets it up as a business. It insists on more adequate factors of safety in plant design, in producing water of definite quality without variation, and in fitting reclamation into a utility organization for the storage, sale, and distribution of the water. Naturally that type of municipal department which is empowered to fix rates, collect revenues and run a business should be selected to handle reclamation; rather than a department whose sole function is to dispose of sewage at least cost and nuisance.

Realizing the present limitations and handicaps of sewage treatment, the department of water and power of the city of Los Angeles constructed a sewage experimental station in May, 1930, for the purpose of refining sewage treatment and determining costs for adequate purification. The plant



General view of experimental plant.
Settling tanks at right and aeration at left.

has been operating continuously since that date. Designed to treat 200,000 gal. per day, the plant was placed on one of the worst sewers in the city, receiving strong domestic sewage and industrial wastes. It uses a combination of the separate-sludge and the activated-sludge processes as a starting point for more complete investigations. Modifications and experiments have been directed toward the reduction of operating costs and the prevention of nuisance. Some of the special features of the study include:

1. Separate sludge-digestion process.
   (a) Adjustment of *pH* in raw sewage to effect maximum sedimentation in preliminary clarifier.
   (b) Increasing percentage of solid removal by employing lower rate of inflow in gallons per square foot per day.
   (c) Dewatering of excess activated sludge, mixing it with fresh sludge and adjusting with lime when necessary before adding mixture to digestor.
   (d) Withdrawal of digested sludge simultaneously with the admittance of raw sludge, which reduces overflow liquor to a negligible minimum.
   (e) Storage of digested sludge for further dewatering, chemical conditioning and filtration by vacuum filters.
   (f) Utilization of gas from digestor for power purposes.
   (g) Utilization of heat in gas generator to heat digestor.
   (h) Utilization of dried sludge for fertilizer.
2. Activated-sludge process.
   (a) Development of mechanical agitation with a minimum volume of air.
   (b) Determining proper percentage of sludge return for various rates of total solids circulated.
   (c) Controlling conditions leading to bulking of sludge.
   (d) Modification of two-stage treatment.
   (e) Employing double sedimentation for final clarification.
3. Filtration.
   (a) Complete purification with coagulant, superchlorination, sedimentation, filtration and dechlorination, with activated carbon for a portion of the activated-sludge effluent.

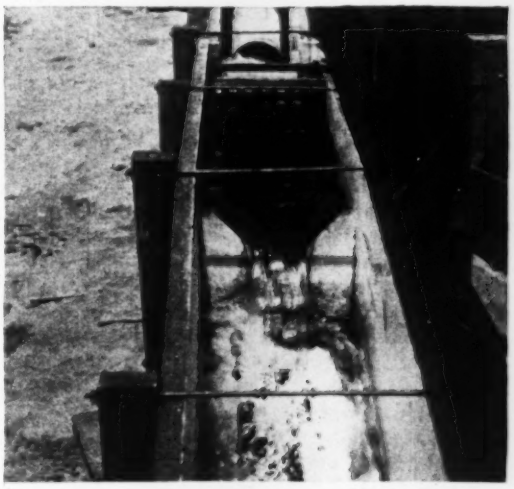
In short, it has been felt necessary to improve materially the processes of sewage disposal, to increase mechanicalization, to provide more liberal factors of safety and provide adequate technical and laboratory supervision. Results have been particularly encouraging. Cost data have been secured to determine cost of methods suitable for our type of sewage and adequate for the uses to which water is to be put. For irrigation and industrial purposes a filtered activated-sludge effluent is proposed.

Possible Reclamation Projects

The various studies of reclamation now under way have not provided conclusions as to any definite method of reuse. Various plans considered include: (1) irrigation use; (2) industrial use; (3) replenishment of the underground supply; and (4) as a direct adjunct to water supply after complete purification. In any event, reclamation plants will be built at the highest possible elevations and nearest the points of use. The character of sewage to be treated at any of the proposed sites is being carefully investigated.

There is considerable logic in using reclaimed sewage only for irrigation purposes. Its nitrogen content remaining in solution meets two-thirds of the fertilizing requirements for the most expensive crops. Also, there is less superstition and prejudice likely to be raised against it. However, it would involve long force mains, pumping plants and separate distribution systems. Further, it would involve taking water from the city of Los Angeles to outlying areas, a procedure which is prohibited by city charter except where authorized by a two-thirds vote at a duly called election to vote on such a project.

The treatment, pipe lines, pumping plants, storage reservoirs and distribution works to a number of areas needing the reclaimed water can be financed for a cost equal to that which those areas now have spent for water. The city of Pomona (four years ago) was the first city to install a complete activated-sludge plant with the intention of selling the water for agricultural purposes. An irrigation company financed the distribution system



Reclaimed water as it leaves the experimental reclamation plant

from the plant. The net cost of operation is far less than the cost of getting rid of the sewage, even though the price of water really was fixed too low, due to lack of precedent. It averages less than 2c. per 1,000 gal. The Pomona plant has a capacity of about 1 m.g.d., showing that even small cities can work out reclamation.

The use of reclaimed water for industrial purposes is particularly desirable in certain sections of the city. In the harbor area, for example, the sewage has a hardness lower than any water in southern California. The price for industrial water in large amount is 8.5c. per 1,000 gal., which is higher than can be obtained for irrigation sales. The cost of storage and distribution works for industrial reclamation is less than for irrigation or replenishing groundwater. In certain areas of the city the reclaimed water could be softened at the treatment plant for less cost than the various users are now spending for softening the present water supply at their own plants.

Replenishing Gravels—The pumping of reclaimed water back to gravels to replenish underground supplies is being carefully investigated. In fact, the water treated at the experimental plant is put onto natural sand beds about 1½ miles above one of the city's main infiltration galleries. A close check is kept on the various chemical transformations in its underground journey. Under certain conditions this plan is eminently practicable, since 75 per cent of it, after months of traveling, may be used for domestic purposes.

Generally speaking, replenishment by reclaimed waters

and floodwaters is not as sound as might appear at first thought. It is estimated that with the past eleven years of subnormal rainfall and no increased rate of overdraft, it would take fourteen years of continuous pumping of reclaimed sewage back into the gravels to bring their water content back to normal. Yet the wet years of the probable 24-year cycle will recharge them in a few seasons. Certainly it would be uneconomical, if not wasteful, to use this method to fill the gravel beds and then have a series of wet years surcharge them and waste large floodflows. Replenishment of gravels within the city is practicable as long as reason is used to correlate the amount that should be pumped back with the groundwater levels. Since 85 per cent of the sewage flow in the area belongs to the city it should not be used for outside areas which alone need recharging. It is apparent that the various problems of replenishing groundwaters are involved.

Domestic Use?—When sewage has been completely treated in a superactivated-sludge plant and is then put through the entire gauntlet of water purification, why should it not be used directly for domestic purposes? Why should its reinstated purity be lost by using the water for less noble purpose? True it is that adequate precautions must be taken in such treatment, and, if need be, a design even more liberal than now thought necessary may be employed. However, the saving in distribution, storage, pumping and other costs more than warrant direct use.

The publication of cost data resulting from reclamation studies is not feasible at this time. The actual cost of any method of sewage disposal which merely "disposes" is clearly chargeable to that branch of municipal affairs, and only the added cost of treatment necessary for reclamation should be charged to reclamation. In the present case this involves, for a large plant, an added installation cost of about $36,000 per million gallons capacity and $10 per million gallons for treatment. To these costs must be added the installations for pumping, storage and distribution, together with operation costs including pumping, depreciation and overhead. The reclaimed water will have a value of from $55 to $85 per million gallons. It is evident that there is ample margin for many practical projects.

The need for reclaiming sewage for outlying areas which are awaiting the development of the Colorado River is imperative. In the city the need is less urgent, but preparations are being made to utilize sewage reclamation when the proper time comes and by a plan based on a consideration of all the attendant circumstances and a thorough investigation of the methods to be used.

Low-Water River Bank Erosion

While high water is the more usual cause of river bank erosion, extreme low water in the Wisconsin River causes trouble of this kind, owing to the shifting of the swift current to the sides where cutting action is concentrated. According to a report to the state chief engineer of Wisconsin by H. V. Tenant, engineer of the Portage levees, strips of land 50 to 60 ft. wide and several hundred feet long will be worn away in a single season, and during the last quarter of 1930 it was necessary to stop the erosion at several points by placing brush mat and stone protection.

Stiffener Spacing for Plate-Girder Webs

By OTIS E. HOVEY
Assistant Chief Engineer, American Bridge Co., New York

MOST SPECIFICATIONS for steel bridges include formulas and rules from which to determine the spacing of stiffeners on the webs of plate girders. Several such formulas have been deduced from the assumption that an element of the web plate with its axis inclined 45 deg. downward toward the end reaction acts as a column with its ends fixed in position but free to rotate. The stiffeners are then spaced horizontally so that the strength of the assumed elemental diagonal column satisfies some formula suitable for true compression members.

This theory neglects the fact that, at any point in a web, tensile stresses exist at right angles to the compressive stresses which are of the same magnitude as the compressive stresses. One effect of these tensile stresses is to support the elemental diagonal column and in effect to reduce its length. The result is that the stiffeners are spaced nearer each other than is necessary.

Two sets of tests of deck-plate girders with relatively thin webs indicate that the webs can carry much larger shears without buckling than the shears for which stiffeners must be added to the webs if designed in accordance with most bridge specifications. One group of tests was reported in a paper by Dean F. E. Turneaure, "Experimental Determination of Stresses in Web Plates and Stiffeners of Plate Girders," *Journal of the Western Society of Engineers*, Vol. XII, p. 788, 1907. The second set was reported under the title of "Strength of Webs of I-beams and Girders" by Herbert F. Moore and W. M. Wilson, engineering experiment station of the University of Illinois, *Bulletin* No. 86, May 8, 1916.

For many years the writer has believed that the ordinary methods of calculating the spacing of stiffeners were not the best available, and therefore presents herewith one which he feels is a desirable substitute. On December 11, 1890, Prof. G. H. Bryan read a paper on "The Stability of a Plane Plate Under Thrusts in Its Own Plane," which was published in the London Mathematical Society *Proceedings of 1891*, Vol. XXII, p. 54. In

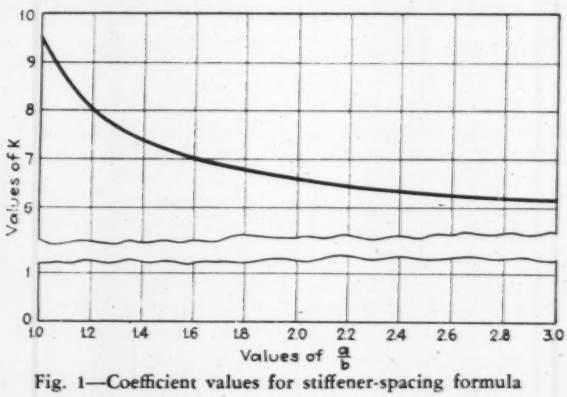


Fig. 1—Coefficient values for stiffener-spacing formula

a and *b* are respectively the height and length of a web-plate panel.

this paper he gave a solution of this problem, and to him belongs the credit of an important addition to the mathematical theory of elasticity. His theory showed that a plate held in transverse alignment at its edges and subjected to tractions along its edges, tending to compression, buckles at failure into units 1, 2 or 3 times its width and that, in practice, the length of the buckles is equal to the unsupported width of the plate. This phenomenon is borne out in practice and has been observed by the writer, who has measured the buckles.

Prof. S. Timoshenko has extended and applied the Bryan theory to several specific cases, outlined in a book, "Applied Elasticity," by S. Timoshenko and J. M. Lessells, 1925, p. 293; and in a paper, "Problems Concerning Elastic Stability in Structures," by S. Timoshenko, *Proceedings,* Am. Soc. C. E., April, 1929, p. 869. Prof. Timoshenko's formula for the elastic stability of the web in a girder is

$$S_{cr} = \frac{k\pi^2 D}{b^2 t} \qquad (1)$$

S_{cr} = the critical unit shearing stress at which the web plate begins to buckle.
b = the length of a panel of the web plate.
a = the height of the same panel.
k = a coefficient which varies in a complicated relation with the ratio a/b.
t = the thickness of the web plate.

$$D = \frac{EI}{1 - \left(\frac{1}{m}\right)^2} \text{ and for a plate } = \frac{Et^3}{12\left[1 - \left(\frac{1}{m}\right)^2\right]}.$$

E = Young's modulus.

$\frac{1}{m}$ = Poisson's ratio.

Inserting the value of π^2 and assuming that $\frac{1}{m} = 0.30$ and that

$E = 29{,}000{,}000$, equation 1 reduces to

$$S_{cr} = 26{,}210{,}500 \quad k\,\frac{t^2}{b^2} \qquad (2)$$

Prof. Timoshenko has evaluated k for various ratios of a/b. Fig. 1 is plotted from his results.

If the values of a, b, the corresponding value of k, and t are known, equation 2 yields a value of S_{cr} at which buckling of the web plate is imminent. When designing a web plate which requires stiffeners they should be spaced so that S_{cr} from equation 2 is greater than the specified allowable gross vertical unit shearing stress by an amount consistent with the relation of the tensional yield point of the material to the specified basic tensional unit stress; hence for S_{cr} may be written fs in equation 2, in which s is the gross unit shearing stress and f is a factor of safety. For practicable application equation 2 may then be written

$$b = t\sqrt{k}\,\frac{5120}{\sqrt{fs}} \qquad (3)$$

Equation 3 is difficult to solve because the value of k depends upon the ratio of a to b, in which only a is known. In the common case a is the vertical unsupported height of the web plate, which is the distance between the flange angles and b is the clear distance between the stiffeners. Fig. 2 is a chart devised to simplify the solution of equation 3 and was constructed by designating the constant in equation 3 as A; plotting the values of $A\sqrt{k}$ on the axis of ordinates and the values of a/b at the top horizontally, and then drawing curves representing $\frac{A\sqrt{k}}{\sqrt{fs}}$ for all desired values of s. For convenient use, mark these curves with the values of s and not with those of fs, which are used in calculating the curves. Finally, draw lines through the origin for various thicknesses of web. The clear distance between the stiffeners is read on the axis of abscissas. In Fig. 2 the value of f in equation 3 was assumed to be 2.

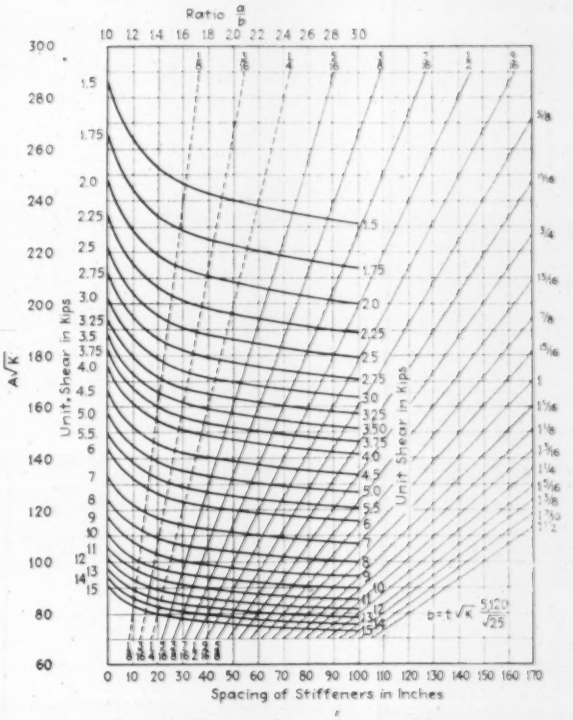


Fig. 2—Diagram for stiffener spacing

Example—A plate-girder web is $\frac{7}{16}$ in. thick, the flange angles are 72 in. apart and the gross unit shear at the end is 8,000 lb. Find the clear distance between the end stiffeners in inches.

1. Enter the chart on curved line 8 at its intersection with the line for $\frac{7}{16}$-in. thickness of web. Read first trial spacing at the bottom = 45.8. And $72 \div 45.8 = 1.57 = a/b$.

2. Enter chart for $a/b = 1.57$ at its intersection with curve 8. Pass horizontally to intersection with $\frac{7}{16}$-in thickness line and read second trial spacing = 46.9 in. And $72 \div 46.9 = 1.535 = a/b$.

3. Enter the chart for $a/b = 1.535$, similarly, and read spacing = 47 in. $72 \div 47 = 1.53 = a/b$.

A spacing or value of b of 47 closely fulfills the requirements of the formula, equation 3.

To determine the spacing of stiffeners for a definite plate girder, the value of s in equation 3 should be the gross unit shearing stress in the web plate at that end of the web panel between the stiffeners which is nearer the end of the girder. The gross unit shearing stress is that due to dead plus live load or to dead plus live load plus impact, depending upon the method of design which is used.

Jadwin Plan for Mississippi Flood Control Approved by Chief of Engineers

No economic justification for greater expenditure—Narrower floodways and channel rectification warrant study—Reservoirs and higher levees regarded unfavorably—United States should be held free of expense for flowage rights and flood damages

NO RADICAL CHANGE in the engineering plan for flood control on the lower Mississippi River is advised by Major General Lytle Brown, chief of engineers, U. S. Army, in his report on the review and restudy of the project. Certain features of floodway design, such as narrower cleared channels and permanent weirs, are recommended for consideration. Channel rectification on portions of the river is considered worthy of further study and research. Reservoirs are dismissed as too expensive. In respect to protection and damages, the report considers that under the existing circumstances "the federal government should be divorced by law definitely and clearly from the payment of any land for flood control and from any damages due to floodwaters, except where the obligation has already been undertaken and the equities of the situation left where they can be properly handled and adjusted, with benefits derived as a basis, namely, in the hands of local authority."

Economic Justification

Except for places of congested population close to main-line levees, the danger of loss of life in floods of the Mississippi River has been and will be trifling, and the economic phase of the problem of flood control should govern. The economic basis, in so far as federal funds are concerned ought to be the annual average property loss due to floods. From such records as are available of actual property loss it appears that the average annual flood loss, with protection works in the stage as of 1927, is $6,000,000 over territory within the range of the waters of the main stream. Due to the unreliability of the record and for the sake of liberality, this figure may be raised to $10,000,000. This assumption indicates that the amount that should be expended by the federal government at this time is not in excess of $200,000,000, interest being taken at 5 per cent. The adopted project, in view of these figures, may be taken as economically sound; and any other project the cost of which is greatly in excess of the adopted project may be considered as economically unsound.

The crux of the principal objection to the adopted project lies in the fact that all local interests are not given equal protection and that there is no general provision to equalize the benefits by the payment of damages due to flood. If the federal government lends itself to the payments for flowage and damages in the cases now in controversy, it will in all equity be obligated to the payment for flowage rights and flood damages over all land overflowed in future. Such payments under the normal procedure will reach very large amounts that will sap the economic foundation of the entire project.

To avoid the escape of water through the Boeuf Basin it is proposed to raise the levees between the mouth of the Arkansas and the mouth of the Red. To confine the maximum probable flood would require levees of such height as to make them quite out of the question. If the 1827 flood is taken as the standard, then the levees in places would reach a height of 40 ft. This plan is the least expensive of any change in the adopted project that has been suggested. It avoids the embarrassment in the Boeuf Basin, though it adds embarrassment in the backwater areas adjacent. The consideration that condemns it is increased general hazard at increased cost.

Preliminary calculations indicate but little encouragement for flood control through rectification and enlargement in the reach between the Arkansas and the Red, the most inviting reach of the river for such operations, the apparent reduction in flood heights is small, and the cost appears prohibitive. However, there are questions here that cannot be definitely answered by theory alone; and there are questions of navigation in addition to flood control. These considerations leave this question open for further study and research.

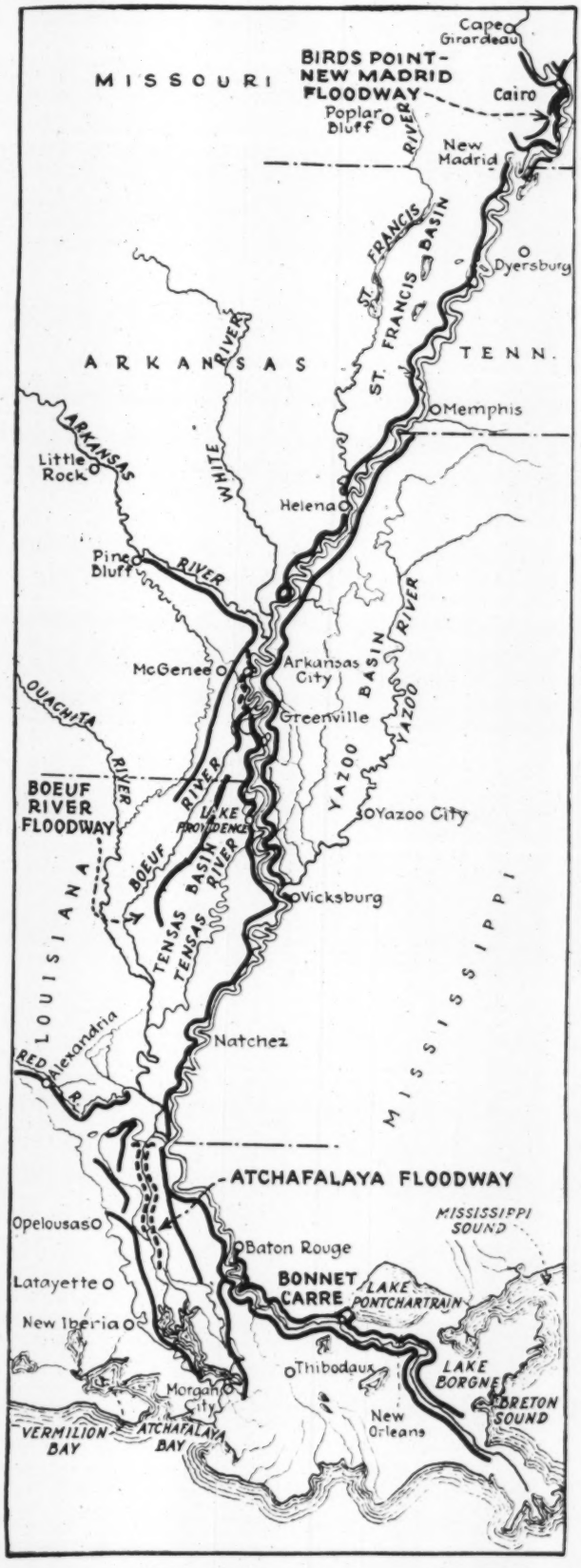
Until a more economical and more reliable method of bank protection is found, there can be attempted no severe process of rectification. Should there be found a suitable method of bank protection, the process of rectification must be a slow and cautious one, using the force of the stream to reduce the cost of the operation to a point within reason.

Reservoirs Found Too Costly

One reason for this report is to examine the feasibility of reservoirs on the Arkansas, the White and the Red Rivers in connection with flood control on the Mississippi. The examinations have been made very carefully. The results show the possibility of a marked lowering of the flood plane below the mouth of the Arkansas by the use of reservoirs, but the cost of the system is very great and cannot be justified at all by its effect in flood control of the Mississippi River.

There is one of these reservoirs, that most notable one, that is deemed wholly impracticable as projected. It is located just above the city of Little Rock, Ark. It floods permanently a large section of inhabited territory, interrupts low-grade rail lines and makes difficult, if not impracticable, the development of navigation on the Arkansas above Little Rock. It is very favorably located with respect to controlling the floodwaters of the Arkansas, which influence Mississippi River floods; but such influence cannot justify its cost of more than $200,000,000.

Generally, the reservoirs examined on the watersheds of the Red, the White and the Arkansas cannot be justified on the grounds of flood control on the lower Mississippi, though they have more influence in restraining



Levee and diversion system of Mississippi flood control adopted by act of Congress approved May 15, 1928

these floods than can any others of like capacity located elsewhere.

The creation of a vast artificial waterway outside the natural channel of the river is the proposal of several plans. There is in all of these the idea of straight channels of increased slope over that of the natural slope. Some of these schemes recognize the necessity of bank stabilization, and others ignore it. Some contemplate locks and dams to overcome the difficulties of increased slope, and others do not. All appear to ignore the economics of the situation or to rely on purely speculative assumptions for justification. None of them can be justified economically at this time even by a most cursory examination of cost. In respect to added facilities for navigation, there is not tonnage enough existing or in sight to justify even a fraction of that part of the cost that it would be necessary to charge to navigation in any of these visionary proposals.

Boeuf and Atchafalaya Floodways

The prime objection to the adopted project comes from the floodways through the Boeuf and Atchafalaya basins. The inclusion of these floodways in the project only makes a virtue of necessity. The surplus waters of every great flood have passed through these basins. So much of the waters of any future flood as can not pass between the levees must again pass through these basins. Objection is raised to the great widths of the floodways and the consequent sacrifice of so much land. There has been a very earnest effort made to avoid any floodway through the Boeuf, but it has failed. All who have examined the approved project agree that a floodway through the Atchafalaya cannot be avoided except by a general application of a system of reservoirs to the entire watershed of the Mississippi. It appears, however, that somewhat more liberal treatment may be given in the side basins west of the main river than has been given in the adopted project, provided the floodwaters in emergency are to be allowed to escape through natural drainage areas instead of breaking out at random to be returned to the main river. But this more liberal treatment on the part of the federal government should be in flood-protection works rather than in so-called damages of flowage rights.

The proposal to narrow the floodways through the Boeuf and Atchafalaya basins, together with fixed weirs at their heads, with crests somewhat lower than now proposed, is regarded as the ultimate solution of the floodway problem. Now the expense, due to the cost of high levees and clearing, and doubts as to maintenance of clearing, is not justified.

Besides the question of land flowage in the floodways, there is a question of so-called damage to railways and highways in the side basins. To provide elevated crossings for all highways and railways for emergency use would be an extravagance that would destroy the entire economy of the protection works. They should not be provided at the expense of the federal government.

Recommendations

The following recommendations are made:

1. That the general method for the control of floods of the lower Mississippi River be as now adopted.

2. That the adjustment of the equities of protection and lack of protection be left to those who alone can apply economically the benefits derived to such purpose, namely, the states and other local government agencies.

3. That the project be stated more definitely but left with all the flexibility possible, as follows:

a. The basis of protection shall be against the maximum probable flood.

b. The extent of the project shall embrace that area of the lower Mississippi Valley between Cape Girardeau, Mo., and the Head of the Passes affected by the waters of the main stream and its backwaters.

c. The protection against floods shall be given by such combination of levees, outlets or diversions from the main stream or its tributaries, and increased discharge capacity of the main channel and auxiliary flood channels as may, in the opinion of the Secretary of War, be feasible and economical.

d. Levee grades, sections, and locations along the main stream and along the tributaries within its backwaters shall be as determined by the chief of engineers and approved by the Secretary of War, and as may be revised from time to time by the same authority as experience may dictate as economical and safe.

e. Waters of extreme floods that cannot be safely and economically contained within levee lines along the main stream and its tributaries shall be allowed to escape therefrom into such areas as afford natural outlets to the Gulf of Mexico outside the main river channel. In these areas such protection works shall be built by the United States as are requested by local interests, are economical and are approved by the Secretary of War, provided that no protection works other than levees along the main stream or its tributaries shall be built by the United States in any state until, by appropriate legislation, the state shall have protected the United States from all claims on account of flood damages of any kind whatsoever within the state.

f. Local interests shall furnish all rights of way and all flowage rights necessary for the execution of this project, except such as the United States has heretofore obligated itself to acquire at Bonnet Carré, La., and at Birds Point-New Madrid, Mo., and has actually acquired at other localities. The furnishing of rights-of-way and flowage rights by local interests is a condition precedent to entry by the United States on the work to which they pertain.

g. The United States may install floodgates in all levees where they cross existing or projected drainage lines and when they are requested by local interests, provided local interests agree to maintain and operate such floodgates. Caring for local drainage is the responsibility of local interests.

h. The United States may, on the request of local interests, finish levees at highway and railway crossings so as to permit of the rapid bulkheading of the openings, which bulkheading shall be the responsibility of local interests. Emergency crossings by highways and railways over levees and flooded areas shall be the responsibility of local or private interests, except at the Bonnet Carré floodway, where such crossings, as may be deemed necessary by the Secretary of War, shall be constructed and maintained by the United States.

i. The chief of engineers shall ascertain, keep on record and report in his annual reports the annual loss due to floods within the scope of this project. Such loss shall be the basis of economic justification for the future prosecution of the various parts of the work of this project.

j. Continuous study and experimentation shall be made in future under the direction of the chief of engineers to perfect:

(1) The effectiveness, durability and economy of bank stabilization of the Mississippi River.

(2) The safety and economy of construction of the levees.

(3) The flood-discharge capacity of the main-river channel and of emergency channels.

(4) The knowledge of the physical and economic effect on this project of such storage reservoirs as may be built or projected on the watershed of the Mississippi River.

(5) The cost of these studies shall be defrayed from appropriations made for the execution of the project for navigation and flood control on the Mississippi River.

k. The total authorization of funds for flood control and navigation on the Mississippi River between Cape Girardeau, Mo., and the Head of the Passes, including all appropriations made since May 1, 1928, is fixed at $344,000,000. Of this amount not more than $61,000,000 shall be spent for works south of the levees on the west bank of the Mississippi River, exclusive of the work on the Red and Atchafalaya rivers, and none shall be expended for rights-of-way for works, flowage rights, or for flood damage of any kind.

Notable Performance in Emergency Levee Building

Four tower excavators with supplementary tractor wagon-grader outfit build six miles (3,428,956 cu.yd.) of full-section levee in five months

By T. H. JACKSON

Brigadier General, Corps of Engineers; President Mississippi River Commission, Vicksburg, Miss.

A LEVEE-BUILDING operation was carried out last year in the Vicksburg engineer district which in my opinion is an outstanding example of good organization and high morale.

The program for the fiscal year 1931 for the flood-control work on the Mississippi River under the existing project provided for a setback levee about 6 miles long immediately below Greenville, Miss. The levee was very high, averaging about 24 ft. net, and had a volume of about 13,500 cu.yd. per station of 100 ft. The situation at the point in question had become so acute during the flood season of 1929-30 that it was considered inadvisable to trust the levee in another high water. So the work was scheduled in the specifications for completion on March 1, 1931. Bids were opened on May 16, 1930. The accompanying table shows the yardage placed, the government estimate of cost, and the low bid for each of the eight items into which the work had been divided.

All the low bids except that for item 8, which was accepted, were, as will be seen in the table, over 25 per cent in excess of the government estimate; hence, under the law, had to be rejected. The question of readvertising was then considered. However, the short period allowed for construction had been a factor contributing materially to the highness of the bids, and the loss of about a month through readvertising would simply have increased the importance of the time limit. It was decided, therefore, that the only chance of having the work completed prior to the next flood season would be for the United States to do it by hired labor. The district engineer insisted that by using available plant his forces could complete the work on time and within his estimate. So on June 5, 1930, he was given authority to proceed.

Progress and Output

Mobilization of plant began on June 6 and was completed on June 10. The major pieces of plan were: unit No. 1, tower excavators, C-3 and C-14; unit No. 2, tower excavators, C-2 and C-7; unit No. 3, nine tractor-wagon units (5 cu.yd.) and two elevating graders. The movement of earth began on June 12, 1930, and was continued to the date of completion, Nov. 10, 1930, at the following rates:

Month	Cu.Yd.	Month	Cu.Yd.
June	317,423	September	824,513
July	601,329	October	859,257
August	719,221	Nov 1 to 10	107,213
Total			3,428,956

The total cost of the completed work, the saving on the government estimate and the saving on the contractor's low bid are shown in the table.

New Practices and Methods

The high pressure under which this work was prosecuted, the limited time available, the great height of the levee, the extreme width of the tower-excavator borrowpit (average 600 ft.), the limited height of the towers of two of the machines and the long average tractor haul of 1,200 ft. required careful planning of the operation. This resulted in the development of a number of new policies and methods, which are so interesting that they will be discussed briefly.

Each of units 1 and 2 consisted of one 72-ft. tower excavator and one 97-ft. tower excavator. Construction of completed levee section by two lifts and by three lifts was tried. It was found that the three-lift method gave more rapid progress, since it lightened the yardage in the

QUANTITIES, PRICES AND SAVINGS ON SIX-MILE MISSISSIPPI RIVER LEVEE

Item	Yardage Placed, Cu.Yd.	Government Estimate Cost Per Cu.Yd.	Low Bid Cost Per Cu.Yd.	Cost to Complete	Saving Over Government Estimate	Saving Over Low Bid
1	473,963	$29.477	$41.489	$85,692.51	$54,017.56	$110,950.00
2	495,517	24.0255	38.189	89,589.47	29,460.97	99,643.52
3	492,167	24.0255	42.489	88,983.79	29,261.79	120,133.05
4	452,975	24.0255	46.189	81,897.88	26,931.63	127,326.74
5	476,801	24.0255	48.189	86,205.62	28,348.20	143,560.01
6	475,371	24.0255	39.789	85,947.08	28,263.18	103,198.29
7	562,162	24.0255	34.189	101,638.89	33,432.34	90,558.68
8	582,094	37.328	37.289			
Total	3,428,956			$619,955.24	$299,706.67	$795,370.29

first and most difficult lift when the headtower rested on the ground, facilitated the return of the bucket and placed the headtower closer to the borrow and the dump for the second lift. The 72-ft. tower using the close borrow placed the first two lifts; the 97-ft. tower of each unit completed the levee section with the third lift, hauling in from the far borrow. The previously employed working day of two ten-hour shifts was increased to full 24-hour operation of three eight-hour shifts. The unit production per hour was increased thereby.

A 10-yd. bottomless bucket was tried, beginning July 14. It was highly successful, particularly in overcoming the bad groundwater conditions, which existed over practically the entire area of borrow. The original bucket was supplemented by three more acquired, Sept. 3, and Oct. 13 and 20. This type of bucket increased the output per load, skimmed out material from wet borrow without gouging out deep holes, and increased the length of gravity backhaul, the life of track cable and the life of bucket.

Maximum distances of 760 ft. from headtower to back of pit were attained, with gravity return by the use of 97-ft. towers and the new bucket, and by a re-designed bicycle carrier for bucket. The re-design of the bicycle consisted of mounting the sheaves on oversized annular ball bearings.

Grubbing was accomplished almost entirely by explosives and caterpillar tractors, abandoning previous practice by using a steam-operated stump puller. The dressing of slopes was accomplished by caterpillar tractors equipped with bulldozers, thereby eliminating the use of a small revolving dragline and mule-drawn fresnoes.

Unit No. 3 (tractor-wagon) was auxiliary to the tower-excavator units, being used for erecting berms across slough and constructing portions of completed levee where borrow, either in quantity or position, was not available for tower-excavator construction.

Operation Sets Record

The above operation set a record for rapid, large and low-priced production on the Mississippi River for a major job. It set a record for a job of magnitude, which it is probable will not be equaled within the life of the present project unless the government forces should again be given a similar one. In such a case it is expected that this record might be exceeded. It proved conclusively that the tower machine, which two years ago had been placed in the discard by many levee engineers, is a satisfactory machine for the construction of high Mississippi River levees: and that such machines can be increased in height to the limit desired for such work, as well as operated much more successfully and economically than they have been in the past. Above all, however, it showed (the fact did not need proof) the value of sound organization and high morale.

To the district engineer, Major J. C. H. Lee, Corps of Engineers, and his immediate assistants, who were responsible for the general planning and supervising of the work, there must be given great credit. Similarly, great credit is due to all of the field area force directly involved. However, to the area engineer, Lieut. M. W. Gilland, Corps of Engineers, and to his four assistants on the job—W. D. Andrews, general foreman; Lieut. J. F. McCartney and Lieut. W. A. Carter, successively in charge of unit No. 3; E. C. Dye in charge of unit No. 2; W. H. Deese in charge of unit No. 1—the greatest credit must go, for it was mainly through the ability and the high morale of their groups that the operation was carried out so successfully.

Full expression of appreciation of the efforts of all who contributed to this operation would be incomplete if mention were not made of the splendid cooperation of that veteran levee engineer, J. Seguine Allen, who, as engineer of the Lower Yazoo Levee District, provided in his usual energetic manner and cooperative spirit all needed rights-of-way, thus eliminating what is so frequently a source of delay.

What Smoke Costs England

Cost of the smoke nuisance in England is $400,000,000 annually. This is based on factors obtained from studies made in Pittsburgh, where the cost is estimated at $20 per capita per year. Costs are proportional to soot-fall measurements. The English have enough observing stations where soot fall is measured to warrant Arnold Marsh, general secretary of the English National Smoke Abatement Society to conclude in *Municipal Engineering* that 35s. per capita is a fair conservative figure, since all of the large cities generally exceed this, as shown by the following figures: London 39s., Birmingham 52s., Glasgow 47s., Liverpool 77s. Three examples were given. Laundry in Manchester costs $1,200,000 more than if the air were as clean as in Harrogate. Replacement of dead plants in a group of municipal parks costs $7,500, which in a clean city would cost but $250. In cleaning government buildings $600,000 would be saved if the atmosphere were smokeless.

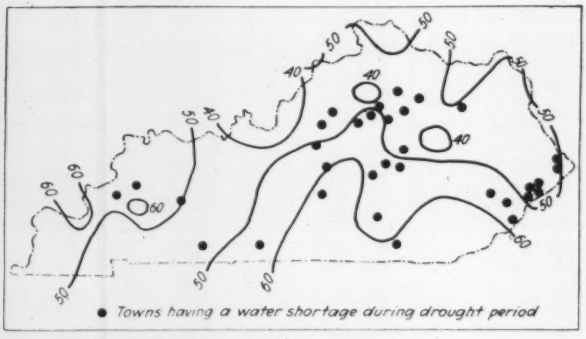
Field Notes on

Water-Supply Conditions in the Drought Regions

How the Drought of 1930 is affecting community water supplies is reported in field observations by one of the editors of *Engineering News-Record*, the third of which appears below. Despite some local rains the drought continues to cause concern among engineers in water-supply service, especially in some of the South-Central states, where last summer's rainfall was 50 per cent or less of normal. They find themselves entering the year 1931 with depleted reserves or entirely lacking reserves and with little prospect as yet of a return to normal. —Editor.

KENTUCKY is enjoying a breathing spell in its struggle to cope with a general condition of depleted water supply. After eleven months of continuous severe rainfall deficiency, streams had dried up, wells and springs had ceased to flow, and empty reservoirs and part-time-operated water systems dotted the state. Not until the light rains which fell during the early weeks of February was the tension relieved at all, and unless the precipitation during the coming months is somewhat greater than its normal value it is likely that reduced water rations must be continued well into 1931.

At the peak of the drought period one-third of the public water supplies of Kentucky had been forced to



Kentucky rainfall during the drought

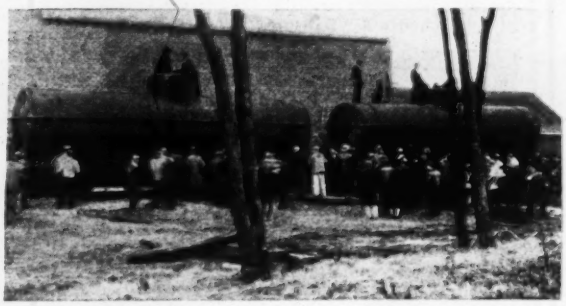
Figures are per cents of normal in the period March 1 to Nov. 1, 1930.

institute emergency measures to assure service to their consumers.

The drought started in Kentucky in March of last year. Rainfall was well above normal in January and at just about its expected value in February, but the remaining months of the year showed deficiencies of such magnitude that the year's total was but 27.55 in., or 61 per cent of its normal value. Prior to 1930 the driest year on record had been 1894, with 34.81 in. For the last ten months of the past year the state received only 50 per cent of its normal rainfall. The driest section was Jefferson County, containing Louisville, and the wettest was in the southeast, near the Tennessee border. It was in the "blue-grass" region of north central Kentucky that water plants were most seriously affected.

In that region runoff is immediate and practically complete because of the rather impervious nature of the clay subsoil. Consequently river stages began to drop rapidly as the drought progressed, until many of the streams became completely dry in the summer with the exception of a few pools scattered along their courses. Two of the larger streams, the Licking and the Salt rivers, also became dry during the summer.

Impounded supplies are frequent in Kentucky, especially in the blue-grass region, where there is little groundwater available except that supplied by rock springs and crevices in the underlying limestone.



First shipment of Kentucky River water arriving at Richmond

Water by Tank Car

The first community to suffer from depleted storage was Shelbyville, 30 miles east of Louisville. The 4,000 people in this town are supplied with water obtained from a low dam across Licking Creek, forming a reservoir which contains 30 m.g. when full. On March 15 the reservoir was full, and a small amount was flowing over the dam. From that time until the middle of February there was little or no flow contributed by the stream with its drainage area of 33 square miles. The demand on the system is normally 0.3 m.g.d., and the water level of the reservoir began to drop steadily. By Aug. 7 the water behind the dam had been reduced to less than 1 m.g., and it became necessary to transport water in tank cars from Louisville. Sixteen cars of 10,000-gal. capacity each were received every day for the next seven months, and their contents were discharged into the clear well of the Shelbyville filter plant. As that amount was but half of the normal demand, the pumping plant was put on part-time operation twelve hours per day, from 6 a.m. to 2 p.m. and from 5 p.m. to 9 p.m. The few inches of rainfall which fell during the early weeks of February, collected by the large drainage basin, were sufficient to replenish the storage; and on Feb. 13 water began to flow over the dam again. Under normal conditions the water overflows all year.

Two impounded lakes having a combined capacity of 245 m.g. are used by Richmond. Here, too, it was necessary to transport water by railroad to supply the town. Once before, in 1925, a dry spell had caused a water shortage in Richmond, and the dam height had been increased at that time. Since then no difficulty had been experienced in supplying the town's demand until the past season. On last March 15 water was flowing over the spillway. Scanty rainfall had its effect, however, and on June 28 it was apparent that a serious water shortage was in prospect.

On Oct. 1 only 30 m.g.d. remained in the lake. It was decided to consider 10 m.g. as a fire reserve and to make use of 18 m.g. contained in a private lake within 1,500 ft. of one of the distribution mains. Pumps, pipe line, chlorinator and all necessary equipment were installed, and the water from the lake was pumped into

Richmond's distribution system. On Jan. 27 the lake's contents had been used up completely, and there had yet been no replenishment of the reservoir. Tank cars were then pressed into service to haul 210,000 gal. daily from Valley View, a watering station of the L. & N. R.R. on the Kentucky River. The water so transported was discharged into the lake of an ice plant in the city, and an emergency pump and chlorinator were set up at that point to force it into the mains. In the second week of February the hauling was discontinued, as enough water had flowed into the reservoirs to enable the regular system to resume operation.

Lexington's Supply Affected

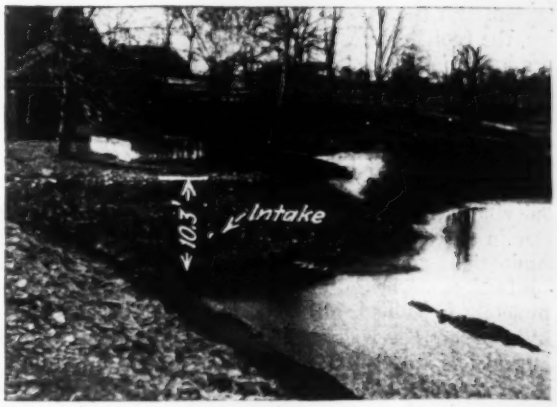
Lexington was the largest city affected. Under normal conditions the city uses water at the rate of 6 m.g.d., drawn from four impounded reservoirs supplied by the drainage area of 13 square miles. The four lakes held a total of 1,640 m.g. on April 1. Because of the steadily receding level as the drought continued, measures designed to curtail the demand were put into effect in September.

The only available source with sufficient flow to supply the city's need was the Kentucky River, 6½ miles away. Construction of a 20-in. pipe line and emergency pumping station at the river was begun in October, and they were ready to be put into service on Dec. 10. The

Emergency supply for Lexington, Ky.
A pumping station on the Kentucky River delivers water through a 20-in. pipe line to the city pumping station.

construction of the line involved rock excavation for long stretches, including the steep bank of the rivers. Steel pipe was used for the part of the line ascending the river bank, and the remainder was built of cement-lined cast iron. The emergency pumping station at the river's edge pumps 4 m.g.d. through the new line to an existing pumping station, used to lift the contents of the lowest lake to the filter plant.

Several other towns found it necessary to transport water. Morehead, which takes its supply from a fork of Licking Creek, started hauling 30,000 gal per day in tank cars on Sept. 6, when the creek became absolutely



Intake pipe above water level at Richmond, Ky.

dry. An additional quantity was obtained from an emergency well drilled into the dry streambed. Morehead's condition is also somewhat relieved now. Greenville, the most severely affected community in the western part of the state, hauled water until quite recently from Central City on the Green River.

Lancaster, 40 miles south of Lexington, shut off its pumps on Feb. 4, and they have not resumed operation yet. When visited recently, a pitiful little pond was all that remained of the impounded reservoir; and a little trickle no more than 2 ft. wide was all that was flowing into it. The man in charge, whom I found setting out fence posts, told me he had no idea when he would be able to start up again. When the lake was about to become exhausted he had used the last few gallons to fill the elevated tank the town boasts of, so as to assure protection against at least one fire, and had then gone around and shut off the town's several hundred services.

Tastes Develop in Louisville Supply

Louisville, although blessed with an ample supply, has been suffering from a disagreeable tasting water resulting from the low stage of the Ohio River. The combination of the unprecedented low discharge, and the now complete canalization of the river has brought about entirely new biological conditions. The Ohio at Louisville is now more like a lake than a river. Turbidity has decreased and algae have enormously increased. Where heretofore a plankton count of 1,200 per cubic centimeter, during 1930, was the maximum to be anticipated, counts of from 4,000 to 5,000 were not uncommon. The taste problem accompanying the luxuriant algae growth has not yet been solved completely. Super-chlorination is being tried, but as there is no means for effecting subsequent dechlorination, the water was still unsatisfactory as a beverage.

The hot dry spell took toll in Louisville in still another fashion. Maximum-hour pumping loads went way up out of sight. Prior to the past year the ratio of maximum-hour to average-day demand had been between 1.79 and 1.97. In 1930 that ratio attained the surprising value of 2.86.

Early in the summer the state department of health recognized the dangers to public health incident to the depleted conditions of water supply and carried out the most extensive typhoid immunization program ever initiated in Kentucky. Serum for a million people was sent out, and it is estimated that three-quarters of that number were immunized. Had it not been for that

program and the careful supervision of emergency supplies, the typhoid rate would undoubtedly have increased alarmingly. As it was, the figures for 1930 showed an increase of 21 per cent over the 1929 rate.

A rather widespread outbreak of acute intestinal disturbances occurred in January and February of this year in cities using Ohio River water. Ashland, Ky., Huntington, W. Va., Portsmouth, O., Cincinnati and Louisville were all attacked. Although the treated river water in all cases had a musty-decay-like taste, bacterial examinations consistently failed to indicate the presence of infection. The outbreak of sickness had not been completely explained, although in the opinion of public health officers the water contained an intestinal irritant, chemical in nature, resulting from the decomposition of organic wastes present in the river. With a decreased river discharge and an undiminished sewage load there is no doubt that such decay took place, and in the absence of bacterial indications it is difficult to explain the disorders otherwise. —F.W.H.

Construction Cost Decrease Is Confirmed in New Orleans

UNIT prices on two similar canal contracts awarded in New Orleans, La., on Aug. 29, 1929, and Oct. 1, 1930, indicate a drop of approximately 18 per cent in construction cost, confirming experiences in New York City and Detroit noted in *Engineering News-Record*, Jan. 29, 1931, pp 193 and 195. The two contracts, relating to concrete-lined canals, contain approximately the same items, although the quantities differ due to the fact that the earlier job was for a longer and wider canal. Both, however, are lined with concrete sheet-piling and 1 : 2½ : 5 concrete bottoms. In preparing the tabular comparison of unit prices, it is assumed that the quantities called for in the smaller project also apply to the larger. The unit prices tabulated opposite the quantities for each job are the averages of seven low bidders in each case. The same contractor was successful in obtaining both contracts. After finishing the large canal he moved his men and equipment directly to the smaller job.

UNIT PRICES ON TWO NEW ORLEANS CANALS

	—Average 7 Low Bids— Aug., 1929	Oct., 1930	Per Cent Change
130,000 cu.yd. excavation	$0.97	$0.39	—60
100 cu.yd. brickwork	19.80	15.63	—21
20,000 lin.ft. reinf.-concrete sheetpiling	15.95	15.00	— 6
10,400 cu.yd. 1:2½:5 concrete	9.96	9.85	— 1
28,000 sq.yd. surfacing	.45	.36	—20
940,000 lb. reinforcing steel	.038	0.33	—13
1,000 lb. cast iron	.073	0.82	+11
270 M. bd.ft. planking in subgrade	50.70	32.55	—36
5,000 lin.ft. yellow pine creosoted piling, in place	.87	.98	+12
140 M. bd.ft. lumber for bridges, in place	93.00	89.82	— 3
Drain pipe in place:			
100 lin.ft. 36-in.	6.02	4.85	—19
100 lin.ft. 30-in.	4.73	3.34	—29
600 lin.ft. 27-in.	3.52	2.63	—34
1,900 lin.ft. 24-in.	2.24	1.79	—20
2,100 lin.ft. 21-in.	1.79	1.28	—28
1,200 lin.ft. 18-in.	1.37	1.05	—18
1,600 lin.ft. 15-in.	.95	.80	—19
500 lin.ft. 12-in.	.77	.57	—26
2,300 lin.ft. 10-in.	.58	.48	—17
200 lin.ft. 6-in.	.39	.28	—28
Manholes in place:			
390 lin.ft. No. 1 (6)	13.50	12.52	— 7
48 lin.ft. No. 2 (8)	15.47	14.46	— 7
12 lin.ft. No. 3 (2)	17.30	17.15	— 1
Catchbasins in place:			
10 each No. 1	46.60	45.60	— 2
70 each No. 2	51.10	49.06	— 4
10 each No. 3	55.00	51.35	— 6
10 each No. 4	60.00	54.14	— 9
75 each No. 5	64.50	56.43	—13
20 M. bd.ft. cypress curbing in place	84.20	67.61	—18
Total	$689,357	$567,117	—18

LETTERS TO THE EDITOR

Load Distribution in Hoover Dam

Sir—The Hoover Dam project, as described in the *Engineering News-Record* of Dec. 25, 1930, is without question the most colossal engineering undertaking under way at the present time. For a structure of such unprecedented magnitude it seems strange that more comment has not been made as to the underlying principles governing the design, especially the question of stress distribution between concrete and the foundation rock.

It is hard to conceive of so great a mass of concrete acting as a monolithic structure, and the question naturally arises as to what the limiting height of a structure of this kind really is.

The specifications provide for a maximum pressure of 30 tons per square foot; and since a column of concrete 400 ft. high weighs 30 tons per square foot, the question as to how a column nearly twice this height can be distributed over the base is one which, the writer feels, we know very little about.

From a study of the cross-section shown on p. 1,013 of the *Engineering News-Record* it appears that, if we are safe in assuming that the mass could act as a monolithic structure and if we apply the straight-line formula for stress distribution over the base, we would have a toe pressure of close to 40 tons per square foot for dead load alone. While it is conceivable that this pressure may be relieved by filling the reservoir to El. 935, there still remains the question as to whether the maximum dead-load pressure is under the toe or at a point approximately 150 ft. back from the toe.

It is to be hoped that before this project is definitely under way a free discussion may clear up any doubt as to the design of so important a structure.

STERLING JOHNSTON.

Pittsburgh, Pa.,
Jan. 19, 1931.

The Sacandaga Reservoir

Sir—The following is in reference to the article in the issue of *Engineering News-Record* of Dec. 25, 1930, entitled "Water-Power Operation Charts Aid in Reservoir Control."

Although the author assumes a hypothetical case, yet it is obvious, because the reservoir capacity and watershed given are identical with those of the Sacandaga Reservoir, recently constructed by the Board of Hudson River Regulating District, of which the author was formerly designing engineer, that he had that project in mind. He neglected to state, however, the fundamental purpose or rather purposes for which the reservoir was built, and in view of the rather extensive litigation in this connection, the writer believes it essential to bring out that in accordance with the statute under which the Board of Hudson River Regulating District functions the reservoir was built for the purpose of regulating the flow of the Hudson River for the public welfare.

Inasmuch as part of the cost of the reservoir has been assessed against municipalities which are benefited by the reduction of flood heights, made possible by the impounding of the spring freshets in the reservoir and also by the improved sanitary conditions, due to the increase in low-water flow by the operation of the reservoir, it is felt that it is important to show that the operation of the Sacandaga Reservoir for power needs is only one of the conditions controlling the reservoir operation.

The desirability of having the reservoir substantially at its low-flow line at the time of the inception of spring floods led to the study of the possibility of maintaining a minimum flow and at the same time utilizing all the available storage for the production of the maximum amount of energy. The thought of such a scheme of operation was outlined in the annual report of the New York State water-supply commission for 1911, when the writer was office engineer. It was further discussed by him in Vol. 90 of the *Transactions* of the American Society of Civil Engineers for 1927.

EDWARD H. SARGENT,
Chief Engineer, Board of Hudson River Regulating District.

Albany, N. Y.,
Dec. 31, 1930.

NEWS OF THE WEEK

Hoover Dam Contract Awarded to Six Companies, Inc.

The contract for the construction of Hoover Dam, bids for which were opened in Denver on March 4 (see *Engineering News-Record*, March 5, p. 409), was awarded on March 11 to the Six Companies, Inc., which submitted the lowest bid, $48,890,995. Two other concerns bid $53,893,878 and $58,653,107 respectively.

Contractor Drops Estimating Fee to Get Dallas School Job

After the Dallas school board had rejected all thirteen bids on the new Robert E. Lee school because the contractors included estimating fees of $1,650 in their proposals (*Engineering News-Record*, Feb. 26, 1931, p. 373) the Eckert-Burton Construction Co. on the second call for bids resubmitted its original low bid less the amount of the fee and was awarded the contract. The original low bid was $107,732, the resubmitted figure was $106,082 and the contract price was $105,742, on an alternate $340 less than base bid price. Of the original thirteen bidders, but three firms submitted proposals the second time. The second set of bids contained the specific clause that the bidder had entered into no estimating fee agreement.

Bids Opened for Ward's Island Sewage-Treatment Works

Bids were opened on March 9 for contract B, section 2, of the sewage-treatment works for New York City on Ward's Island. This contract calls for the construction of preliminary and final settling tanks, aeration tanks, substructures for operating galleries, preliminary and return sludge storage and decantation tanks, with appurtenant pipes, conduits, drains and other accessories. Nineteen bids were received, the lowest, $3,800,000, from the W. H. Gahagan Co., Inc., and the highest, $7,000,000, from the Arthur McMullan Co., Inc. The plans for the plant were outlined in *Engineering News-Record*, Feb. 12, p. 293.

Bids for Welding Building Show Money Saving Over Riveting

Evidence that welding as a method of building construction has arrived at a point where it is cheaper than riveting in many cases is found at Nela Park, Cleveland, where the General Electric Co. is to start work immediately on the construction of an industrial building. This building, to be devoted to the manufacture of wire for the incandescent lamp department of the company, will be erected under contract by the Austin Co., of Cleveland, and 1,000 tons of steel will be used.

Competitive bids were submitted for both welding and riveting in fabricating the steel, and by using welding it was found that $2,100 will be saved, or $2.10 per ton, over the riveting method. It is expected that the building will be completed some time during the present year.

Group Planning of Commercial Buildings Gets First Major Test in New York

Work on huge "Metropolitan Square" project covering three blocks and involving about a dozen large buildings, one larger than the Empire State, to start in June—To cost $250,000,000

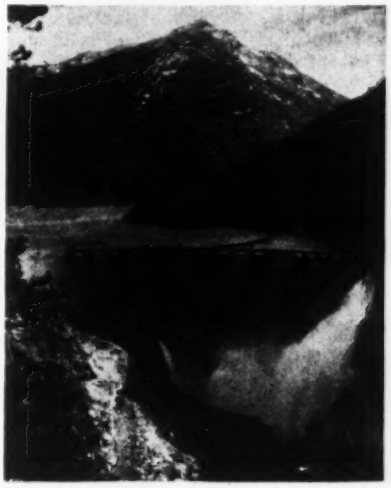
A COORDINATED building project, greater than anything yet attempted and in many respects surpassing the most imaginative pictures that city planners have drawn of the city of the future, is to be put under contract in June of this year in New York City. Announcement of this fact was made last week by the Todd, Robertson & Todd Engineering Corp., which has charge of the project for John D. Rockefeller, Jr., the owner. Officially known as "Metropolitan Square" and popularly called "Radio City" by virtue of the fact that Radio Corporation of America and its subsidiaries will occupy a large block of space in the central building, the project covers three full city blocks, each 200x600 ft., fronting on the east on Fifth Ave. as shown in the accompanying plan drawing. Involved in project is a central unit of 68 stories, having 2,000,000 sq.ft. of rentable floor area, something over 150,000 sq.ft. more than is in the 85-story Empire State building. This is flanked by two 45-story buildings, a sound picture theater with a seating capacity of 4,500, a vaudeville theater with seats for 6,500, a unique elliptical building of fourteen stories and several other office buildings of nominal height. It is possible that another theater, to be occupied by the Metropolitan Opera Co., will be added to the group.

In architectural conception, the project is unparalleled. The buildings were literally planned as machines, such factors as light, air, elevators, pedestrian and vehicle traffic, trucking and parking facilities taking precedent over exterior form and appearance. Thus each block was developed as a single building, in so far as the building code was concerned, with the tower portions (one-quarter of the plot area as fixed by the building code) concentrated. By virtue of this expedient the central building rises without setback on the north and south faces for approximately 50 stories. The low buildings shown on the accompanying model are, under this plan, carried to their greatest possible height under the building law. The several towers in the plan are staggered so as to assure light and air. The location of the central plaza was dictated by similar considerations. All buildings are connected by underground passageways. Parking areas or garages occupy the remainder of the first basement area. The second basement is devoted to large central trucking and shipping facilities.

Two crosstown streets pass through the development. Both streets have been widened by reducing the width of the center block.

The central building is unusual in several respects. Its tower is approximately 96 ft. wide by 200 ft. long, introducing a considerable windbracing problem. Provision has been made for

DIABLO RESERVOIR FILLS UP



Recent heavy rains in the Puget Sound district have filled the reservoir in the upper Skagit watershed back of the new $4,000,000 Diablo Dam to its capacity, forming a lake extending up the Skagit River for 7 miles containing 90,000 acre-ft. of water. The inflow of water is so great that it has been necessary to open several of the nineteen tainter gates. The Diablo Dam is a unit in the Skagit hydro-electric development of the city of Seattle's municipal lighting department.

this by concentrating all elevators in the central core of the tower, permitting substantial crossbracing. The space between elevators and outside walls is unobstructed by columns, and limited to 27 ft., the maximum distance over which light from the windows is effective. Thus when a bank of elevators is stopped off, a setback is made in the building to keep within this 27 ft. The setbacks shown on the model correspond to the tops of the several elevator banks. Numerous large broadcasting rooms in this building will require trusses and girders of long span, but the fact that these rooms are located outside the tower simplifies the problem.

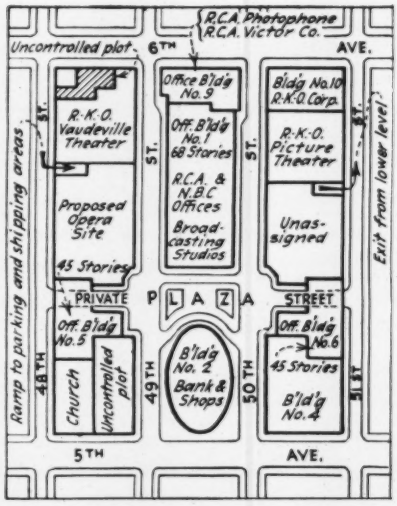
The Fifth Ave. building was made elliptical in plan in order to open up the front corners and thus make the interior plaza the real focal point of the layout. The street floor of this building is devoted to shops, the second floor to a huge banking room requiring a complicated roof framing of trusses and girders. The upper floors are to be used for wholesale display purposes, which require artificial lighting and are therefore not penalized by the considerable depth of the building and numerous interior rooms. It is only fourteen stories high, partly because of the tower concentration in the central building and partly because a height of only 125 ft. before setback is permitted on Fifth Ave.

The 45-story buildings flanking the main building are T-shaped to assure maximum light. A private street is carried through them as shown on the plan. Otherwise they will not present particularly difficult structural problems.

The several theaters involve many architectural innovations, but except for the size of the sound theater will not be different structurally from other buildings of similar type.

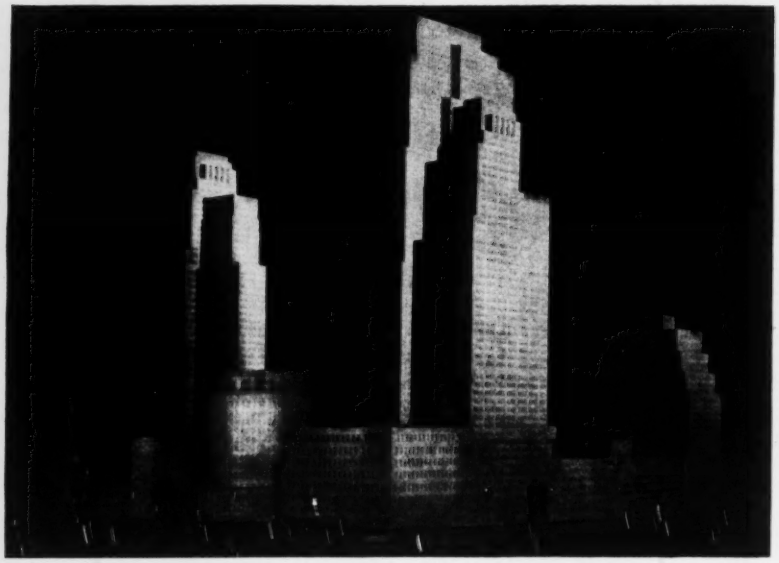
The two theaters and the low portion of the central building on Sixth Ave. have been placed first on the construction schedule. Work will commence on them in June. Already the old buildings on much of the site have been demolished. The entire project is scheduled for completion by the end of 1932.

Three architectural firms have joined forces in developing Metropolitan Square: Reinhard & Hofmeister; Corbett, Harrison & MacMurray; and Raymond Hood, Godley & Fouilhoux. A special designing organization will be mobilized to handle the detail work in the near future. H. G. Balcom is in charge of structural design, and it is estimated that 125,000 tons of steel will be required.



Plan of Metropolitan Square buildings

Entire plot of three blocks developed as a unit with light, air, elevators and tenant service prime considerations. Note how the elliptical shape of Fifth Ave. building opens up the plot and emphasizes the interior plaza.



Metropolitan Square—Fifty-First Street corner at Fifth Ave.

Model shows how tower rights of a whole block have been concentrated in one or two buildings. Main tower is 68 stories. Twin openings through the 45-story building in foreground accommodates private street across the three blocks of the plot. Small opening farther west is exit from parking garages and shipping stations on lower levels.

A.S.T.M. Perfects a District Organization In New York City

THE first general meeting in New York City for many years of the members of the American Society for Testing Materials was held on March 5. The meeting inaugurated a plan to hold similar local group gatherings two or three times each year. A permanent committee set-up under the chairmanship of F. M. Farmer, of the Electrical Testing Laboratories, 80th St. and East End Ave., New York City, was completed. The meeting on March 5 was addressed on the subjects of concrete, non-ferrous metals and electrical materials, respectively, by A. E. Lindau, American Wire Fence Co.; Paul D. Merica, International Nickel Co., and J. A. Capp, General Electric Co. Mr. Farmer announced that the next meeting will be held some time between Oct. 15 and Nov. 15 and probably will be devoted to several papers on a single subject. Some 200 members and guests were present.

Paper on Cement and Concrete

The papers were not detailed or unduly technical, but some of Mr. Lindau's remarks on limitations of present knowledge in the field of cement and concrete deserve recording. Mr. Lindau mentioned the possibility that laboratory data on cement and concrete were being collected faster than they could be applied in practice. In remarking upon the upward trend in concrete strength Mr. Lindau pointed out that 7,500 lb. per sq.in. at 28 days seems to be about the upper limit, with standard practices of the present. He also mentioned the importance and simple nature of the rule that Prof. Withey, of Wisconsin, has recently proposed — namely, that the strength of concrete increases as the logarithm of its age. Mr. Lindau emphasized the fact that concrete is a plastic and not an elastic material, its permanent compression or shortening under load in a ten-story building being in the nature of about $\frac{1}{8}$ in. per story. This is not altogether a disadvantage, for it is probable that the walls and other parts of the building also shorten in about the same proportion and it is quite probable that plasticity relieves overstress in some members. Nevertheless, in Mr. Lindau's opinion, plasticity and its various connotations stand in the way of a general upward revision of concrete working stresses.

Coming to the subject of durability, Mr. Lindau emphasized the close relation between it and density. Eventually it may be necessary to specify a minimum cement content in order to insure durability, if the tendency toward developing high-early-strength cement and therefore toward reducing the cement content continues. This particular danger, in Mr. Lindau's opinion, is inherent in the selling of concrete by central mixing plants competing on the basis of strength alone.

Public Land Grant to States Recommended In Committee Report

TRANSFER to the states of all unreserved and unappropriated public lands within their boundaries is recommended by the committee on the conservation and administration of the public lands in its report made to President Hoover on March 9. This committee was named by the President in the fall of 1929 and consists of the secretaries of the interior and of agriculture and twenty other members, thirteen from the public-land states and seven from the Eastern states. For a preliminary analysis of the problems involved reference may be made to *Engineering News-Record* of July 25, 1929, p. 137, and of Sept. 12, 1929, p. 427.

Some Areas Reserved

The committee recommends that areas desirable for national defense, reclamation, reservoirs, national forests, parks or monuments, and migratory bird refuges be reserved by the federal government. Remaining areas, valuable chiefly for forage production, should be granted to states which will accept them, while responsible administration and regulation should be provided for those lands the states decline to accept.

An act of Congress granting the transfer is suggested, with state legislation to make the change effective. If a state does not accept the grant or fails to pass the necessary measures within ten years, the establishment of a national range composed of the public lands by presidential executive order is recommended.

Conservation of Water

In regard to conservation of water and regulation of flow of streams, the committee says:

We approve and adopt from the report of a committee of the irrigation division of the American Society of Civil Engineers made Oct. 4, 1928, the following:

The conservation of the water in the rivers and lakes of the country should be under public control, and in order to lay a proper foundation for the making of comprehensive plans the federal and state governments should gather data, compile statistics and conduct studies necessary to determine the feasibility of projects.

The regulation of the flow of streams for the prevention of floods and for the best possible utilization of the waters should be undertaken by the states, or jointly by the United States and the states, under such suitable forms of cooperation as may be appropriate under the constitutional authority now delegated to each. They should prepare and adopt comprehensive plans for such regulation and should bear an equitable portion of the cost of water-storage and flood-control work when the economic aspects after full investigations are found to be favorable, and the remainder of the cost should be allocated to flood-control, irrigation, power development, municipal water-supply and other purposes.

Where protection against flood waters results from the regulation of streamflow by means of reservoirs or otherwise, the proportion of the cost of the flood-control work not assumed by the federal or state government should be assessed against the lands and other properties which receive benefit therefrom.

Ohio Bond Decision Checks Public Work

As the result of a decision of the Ohio Supreme Court invalidating bonds issued by Allen County to anticipate the payment of assessments on several sewer and water districts within the county, municipal bond issues in the state are being delayed and work on several public-works contracts has been stopped. The decision declares that "taxes must be levied for the use of the public of the district taxed"; a state law authorizing a governmental unit to issue its bonds and levy taxes "in anticipation of the levy of special assessment or the collection thereof" is declared unconstitutional. A rehearing of the case has been asked.

The case arose in Allen County, where the county commissioners in 1924-26 established several sewer and water districts as special-assessment districts. The works were built, payment being made from the sale of county certificates of indebtedness. Later general bonds of the county were issued to retire these certificates, the bonds being secured by the taxable property in the county, though intended to be paid from the special assessments levied on the benefited property.

Collection of the benefit assessments was insufficient to pay interest on the bonds, and a bondholder sued for a writ of mandamus to compel the county commissioners to appropriate tax money for the delinquent payments. The writ was denied by the court in a decision of Judge Allen delivered Feb. 16, 1931. The decision concludes:

"The bonds, in so far as they are issued to pay for improvements benefiting special districts only, are not valid, and in that respect are not issued for a lawful purpose. We hold that the enactments in question, in so far as they authorize the appropriation of the general revenues of the county to such obligations or the levying of a tax upon the real and personal property of the county in order to defray such obligations, violate section 2 of Article XII of the Constitution."

Delivery of Emergency Water to San Francisco Begun

Construction of the pipe line from San Lorenzo to Newark, Calif., to furnish San Francisco with an emergency water supply from the East Bay Municipal Utility District has been completed, to augment the present depleted supply. San Francisco is now receiving 10,000,000 gal. daily (10 m.g.d.) from this source, and with the completion of the pumping plant at San Lorenzo the supply will be stepped up to 16 m.g.d. and later to 20 m.g.d. (*Engineering News-Record*, Nov. 27, 1930, p. 863.)

The contractor, the Western Pipe & Steel Company of California, received a bonus of $40,000 for completing this construction in twenty days less than the specified contract time of 120 days.

Regional Planning Activities in Chicago District Reported

RESULTS of regional planning in the Chicago metropolitan district after eight years of work by the Chicago Regional Planning Association are beginning to be evident. At the annual meeting March 5 the following subjects were indicated as the most important undertaken: planned highway programs and budgets; highway grade separations located at 180 crossings after extensive surveys of types needed, traffic counts and delays; widening projects that begin with right-of-way acquirements long in advance of engineering details; a program of railroad and highway grade separations wherein the public will pay a greater share of the costs to speed up the work; widespread enactment and enforcement of zoning ordinances to which the association contributes the services of its staff; development of procedure and public opinion leading to the establishment of greatly extended park and forest preserve areas and services. In all of these activities the association has cooperated with existing agencies, since its only powers are those of persuasion and its funds a modest $55,000 for staff use only.

Grade Separations Studied

Practically no highway grade separations have yet been built in the Chicago region; therefore the association sent its highway engineer, H. R. Olson, east on a long survey and observation of operation of 33 existing structures. He concluded that every intersection is an intricate engineering problem requiring special study. Observations indicate that turnouts should have progressively shorter radius curves from main road to point of reentry, that curbs are essential, that the designs can be reduced to three types requiring respectively ¼, 5 and 10 acres, that signing is a weak point and that simplest designs are best. Plans for eighteen highway separations to be built in the Chicago region were detailed.

William J. Titus, chief engineer, Indiana state highway commission, described the 30-mile 40-ft. Dunes Relief Road from Gary to the Michigan state line now under construction. Further plans are well along to reduce congestion of traffic around the lower end of Lake Michigan west of Gary through the industrial cities by continuing the Dunes Relief Road west to the Illinois state line. Likewise, M. W. Torkelson, director of regional planning for Wisconsin, reported that 6 miles of the Three State Boulevard had been built toward Chicago south of Milwaukee to the Milwaukee county line. A road with separated slabs, 40 ft. wide, is the type built. Wisconsin summer traffic on main trunks from Chicago, surveys show, is two-thirds out of state, so Wisconsin can well afford to build roads to care for this "tourist crop," in Mr. Torkelson's opinion.

Samuel Insull, Jr., president, Midland

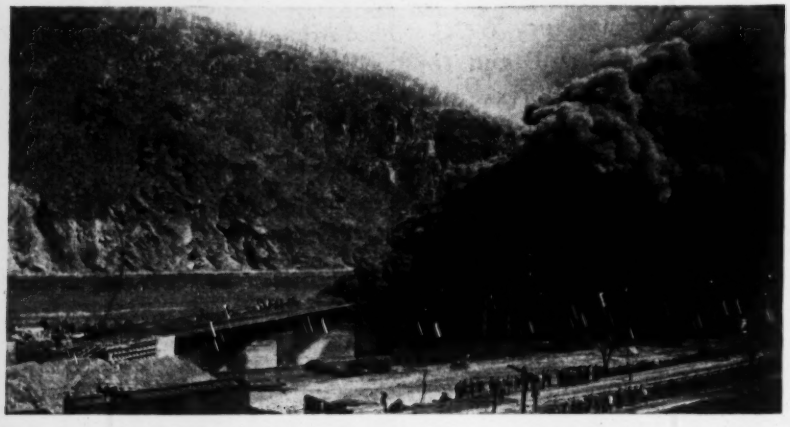
United Co., made a plea for officials to be less obdurate toward power companies asking for power line right-of-way grants, since the wide spread of power facilities removes one of the obstacles to decentralization of population. Power plants now use 414 acres, or 0.3 per cent of 127,000 acres, in Chicago and but 0.2 per cent in the 5,000,000 acres of the whole region. Residences cover 4.1 per cent, forest preserves and parks 1.1 per cent, golf courses 0.7 per cent, and vacant and waste lands 11.6 per cent. Recently built plants require 0.4 ft. of area per kilowatt, whereas 25 years ago seven times as much area was required. The location of power plants is dictated by the requirement of nearness to water and to power demand, but the area required is a small problem from the regional planner's viewpoint compared with the power-line right-of-way necessities.

The officers of the association were reelected: Daniel H. Burnham, president, and Robert Kingery, executive secretary.

Deck Fire Damages New B.&O. Bridge at Harpers Ferry

The new fourteen-span deck-plate girder bridge over the Potomac River at Harpers Ferry, W. Va., which the Baltimore & Ohio R.R. had planned to put into service April 15, was damaged on March 6 by a fire which, according to news reports, consumed a considerable part of the creosoted ties and guards. These same news reports estimated the loss on the $2,500,000 structure to be about $250,000 and stated that the rails and "other metal work were melted and twisted." In reply to a telegram H. A. Lane, chief engineer of the B. & O. Railroad Co., writes: "The newspapers carried a very extravagant statement regarding the situation and the facts are not so extensive as indicated." According to the American Bridge Co., which had the contract for the main steel and had completed its part of the work, sidewalk brackets were being riveted to the structure under another contract when the fire broke out at the West Virginia end of the bridge (shown in the accompanying view) shortly after the workmen left the job for lunch.

The site of the bridge, at the junction of the Shenandoah and Potomac rivers, is a famous one historically and from a bridge engineering standpoint. A bridge of wooden trusses designed by Louis Wernwag and built in 1836 was utilized until 1851, when an iron bridge, developed by Wendell Bollman, of the Baltimore & Ohio, was constructed. This bridge was wrecked several times during the Civil War and was finally reconstructed in 1870. It is still in service as a highway toll structure. In 1894 another railroad bridge was built alongside consisting of three through trusses with deck-plate girder approaches. At this time a tunnel was also driven through the mountain (in the background of the accompanying view) to reduce a sharp curve at that end of the bridge. However, there was still considerable curvature at both ends of the bridge, and the present project was planned to reduce this. The new bridge is built on a tangent through the tunnel, eliminating all curvature at the east (tunnel) end of the bridge and greatly reducing that at the west end. If the steelwork was not damaged in the present fire, the opening of the bridge will probably not be much delayed.



Fire on new B. & O. R.R. bridge at Harpers Ferry, W. Va., consumes wood deck but does not damage plate girder spans

New York State Develops a Natural Gas Field

Natural gas drilling activities in the new western New York field, in the general vicinity of Ithaca and Corning, have recently increased enormously. The latest well to be brought in is said to have a capacity of 100,000,000 cu.ft. daily. The success of the wells already drilled into the gas formation supports the belief that the New York metropolitan area may eventually have natural gas available for use. A line from the field to New York City would be approximately 200 miles long, comparatively short compared with several of the Middle Western lines originating in the Texas Panhandle. According to Robert O. Hoyt, of the Robert O. Hoyt Engineering Corp., of Corning, one of the largest producers is the Belmont Quadrangle Corp., of Bradford, Pa., with twelve wells having a total possible production of 60,000,000 cu.ft. daily. Most of these are capped, but 3,000,000 to 4,000,000 cu.ft. daily under 230-lb. line pressure is being delivered to the pipe lines of the Home Gas Corp., which connect with the New York Transit Co. (Standard Oil Company of New York) pipe lines. Two pipe lines of the New York Transit Co. are also leased to the Columbia Gas & Electric Corp. The Lycoming Natural Gas Corp., which controls the Peoples Natural Gas Co. and is in turn owned by the Standard Oil Company of New Jersey, holds numerous leases and is drilling a number of wells in the Woodhull area west of Corning. In Tioga County south of Ithaca wells are being drilled by the Penn United Gas Co., the Penn Ohio Gas Corp., the North Penn Gas Co. and numerous independent drillers. The North Penn Gas Co. also has a 22,000,000-cu.ft. well in Farmington township. The Hope Engineering Corp., and the Reserve Oil Corp. (Columbia Gas & Electric Corp.) are drilling north of Ithaca, and the Cities Service Co. is active near Woodhull.

Both the Pennsylvania industrial area and the New York metropolitan area are available as a market for this natural gas. Manufactured gas is supplied in New York City by the Consolidated Gas Co., and it is reported that this company is ready to buy the natural gas to mix with its manufactured gas.

Pine Canyon Dam Height Is Ordered Reduced

Reduction of the height and storage capacity of the proposed Pine Canyon dam on the San Gabriel River has been ordered by the Pasadena (Calif.) board of city directors. The reduction was ordered because of the inability of the Metropolitan Water District of Southern California to determine whether it will utilize the city's proposed dam for storage of Colorado River water.

A dam to store 40,000 acre-ft. of water and to be 245 ft. in height above the streambed is proposed now instead of a 295-ft. dam that would store 64,200 acre-ft. The city originally received permission from the state division of water rights to build the high dam. A $10,000,000 bond issue was voted by Pasadena in June, 1929, to provide funds for the project. Samuel B. Morris, chief engineer-superintendent of the Pasadena municipal water department, said at least $1,000,000 would be saved in construction costs by building the lower dam.

The city board of directors, in informing directors of the Metropolitan Water District of its action, indicated that plans to reduce the capacity of the proposed dam do not mean that the board forecloses the opportunity to enter later into an agreement with the district for joint storage of water.

WASHINGTON NOTES

By PAUL WOOTON
Washington Correspondent

Government Likely to Proclaim Local Wage Rates—A.G.C. Takes No Stand on Bidding Fee Question

WITH the President's signature, the Davis-Bacon bill, requiring contractors on federal buildings to maintain local wage rates, became a law. Steps are now being taken by the government departments concerned to devise means of complying with the new act. The interdepartmental board of contracts and adjustments will take up the matter and it is believed that the decision will be reached to put into effect the amendment suggested by contractors which would require the department doing the work to proclaim minimum wage rates in its advertisements for bids. An unsuccessful attempt was made before the final passage of the bill to add the contractors' amendment. It is not believed, however, that anything in the bill prevents the voluntary carrying out of this amendment. The point is being made before the interdepartmental contract board that contractors will add a safety margin to their bids unless it is stated in the specifications the wage rates on which the bids must be based.

A.G.C. Stand on Bidding Fees

No plan has been proposed by the Federal Trade Commission and none has been submitted to the commission by the Associated General Contractors of America with reference to establishment by contractors of a fee for bidding on construction projects. E. J. Harding, managing director, Associated General Contractors, stated that the national organization as such never has taken any position on the practice of charging a fee for bidding and has never taken up the subject with the Federal Trade Commission. Mr. Harding said that the national association is watching with interest the efforts made by contractors in various parts of the country to establish what he described as a contractor's service fee, but he emphasized that it is purely a local proposition that varies both in form and in application to meet conditions existing in a particular state or community. Mr. Harding said that the Associated General Contractors, as a national institution, does not tell the local chapters whether they should or should not adopt the system, because while it might work out successfully in some places, it might not be successful in others.

Field Sought for Convict Labor

Concerned by the extensive use of convict labor on highway and other construction work, the Associated General Contractors is considering the advisability of arranging a conference with the American Prison Association and other interested parties to devise a plan for setting convicts to work in non-competitive fields. Officials of the A.G.C. believe that the matter has been brought to a crux by the industrial depression. The point is made that the effects of convict labor in beating down wage rates and in depriving free labor of employment are now more disastrous than ever.

It is proposed that a possible field for prison labor would be in the rehabilitation of forest land. If some productive use has to be made of prison inmates, it is believed that this use would be the most advisable, since it is in the public service and at the same time discharges a function that is not taken care of to any considerable extent by other agencies. According to the latest estimates compiled by the A.G.C., there are 200,000 convicts employed in public construction work at present. This work includes highway construction, and construction of public buildings, sewage-disposal and water systems and bridges.

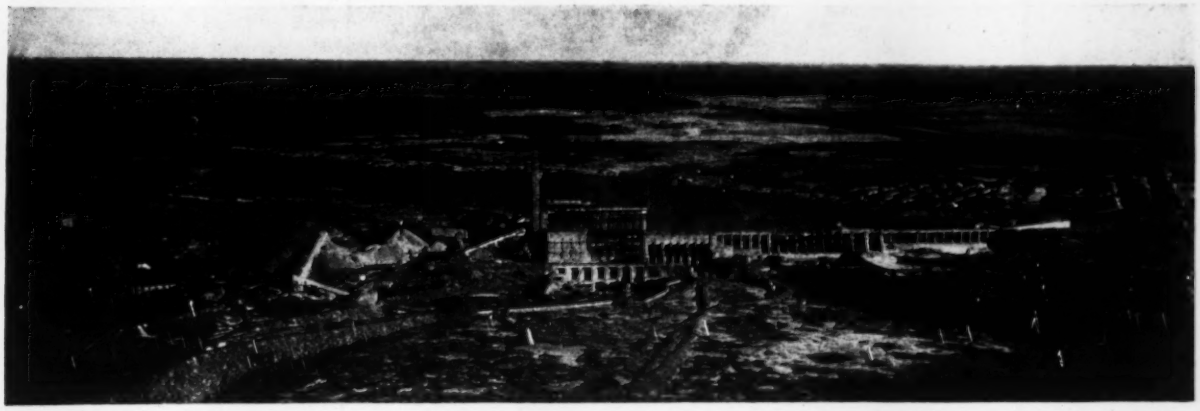
Hetch Hetchy Water Tunnel 60 Per Cent Completed

Sixty per cent of the 28.6 miles of Coast Range tunnel of the San Francisco Hetch Hetchy water-supply project was driven up to Feb. 1. Approximately 8 per cent of the total distance, involving some of the heaviest ground, has been permanently lined with concrete, according to a recent statement issued by City Engineer M. M. O'Shaughnessy. The total estimated cost of this tunnel, described in detail in *Engineering News-Record*, Jan. 15, 1931, p. 96, is approximately $21,000,000. Cost of driving to date has averaged approximately $69 per foot and the cost of lining, which was done by guniting under very unfavorable conditions in heavy ground, has averaged about $81 per foot. Taking credit for about $2,500,000 representing material on hand and the portion of the investment in camps, equipment, etc., allocated to the remaining construction, future work in driving will cost not more than $65 per foot, it is estimated, and practically all of the remaining lining will be placed under more favorable conditions at a cost that is not expected to exceed $40 per foot.

Because of the extra expense resulting from changes required in plant and methods of operation adopted last July to minimize the methane ignition hazard, and the temporary withdrawal of funds to finance the emergency connection with the East Bay Municipal Utility District system, there is possibility of a $2,000,000 deficit in present funds available to complete the Hetch Hetchy system. Within the next two-year period the exact amount of such deficit will be determined and definite plans made to provide the additional funds.

The total amount of bonds voted to date is $79,600,000 and the interest on these bonds during construction amounts to $12,522,000.

SEVEN SISTERS FALLS HYDRO-ELECTRIC PLANT



Recent view of the large hydro-electric undertaking of the Northwestern Power Co. at Seven Sisters Falls, on the Winnipeg River, in the Province of Manitoba. This development will ultimately comprise an installation of six units of 37,500 hp. each, operating under a head of 66 ft. Three units are being installed and will develop about 40,000 hp. under partial head. It is expected to have the first unit in operation by July 1, 1931, and the two others shortly thereafter. The power will be carried to Winnipeg over a transmission line at present under construction.

Minnesota Engineers and Architects Hold Three-Day Sessions

OVERLAPPING meetings formed a continuous three-day convention of the Minnesota Surveyors and Engineers Society and the Minnesota Federation of Architectural and Engineering Societies at St. Paul and Minneapolis, Feb. 26 to 28.

At the 36th annual meeting of the state society, at St. Paul, a good paper on setback building lines in relation to street developments and city planning was read by Herman Olson and discussed by George H. Herrold, city planning engineers of Minneapolis and St. Paul, respectively. The discussion called attention to defects in the present state law governing setback easements. Damages must be paid for "right of view," but if the setback space is desired later for street widening, it must be acquired by condemnation proceedings and the land paid for a second time.

In conservation of rivers and public waters for their most efficient use Minnesota is backward, according to E. V. Willard, state commissioner of waters. The public is indifferent to the problem until pollution, overflow or shortage begin to threaten. A discussion on lake levels related largely to commercial projects for controlling the levels on lakes along the frontier near International Falls. At the joint session of county commissioners and county highway engineers the principal topics were the gasoline tax, better county roads and the methods of financing them.

For president of the state society, A. W. Bedell was elected, with C. L. Methvin vice-president, and L. P. Zimmerman secretary (reelected).

Minnesota Federation Meets

An unusually large attendance marked the tenth annual meeting of the Minnesota Federation, at Minneapolis, with considerable attention to the related aspects of architecture and city planning. Present trends in architecture were discussed by Louis LaBeaume, of St. Louis, director of the American Institute of Architects, and R. A. Plimpton, director of the Minneapolis Institute of Arts. Social complications of city planning for future conditions, as presented by A. C. Godward, include the delay of municipal officers in carrying adopted plans into effect. Progressive results depend largely upon leadership among citizens. Moving pictures of past, present and future plans of Washington, D. C., were presented by George H. Herrold.

Paving subjects included expansion joints and curing methods in concrete paving, presented by E. M. Fleming, Portland Cement Association, and discussed by O. L. Kipp, construction engineer, and F. C. Lang, engineer of tests, Minnesota highway department. Brick masonry for building and construction purposes was reviewed by Hugo Filippi, engineer of the Common Brick Manufacturers Association. He described numerous tests and specifications, the relations of mortar to strength and appearance of brickwork, and dealt particularly with reinforced brickwork. Of particular interest locally was a paper on "Low-Grade Iron Ores in Minnesota," by Prof. E. W. Davis, University of Minnesota, who pointed out the necessity of a more liberal policy of taxation for mining companies if these great deposits are to be utilized.

Officers elected for 1931 include: president, C. L. Motl, assistant maintenance engineer, state highway department; secretary (reelected), K. A. Feucht, St. Paul, Minn.

Construction Started on Seaplane Base in Miami

The work of construction of the commercial seaplane base of the Pan-American Airways, Inc., in Miami was started last month. The base will be on Dinner Key, Coconut Grove, on the site of the United States Naval Air Corps seaplane base during the war. The first building to be erected will be a steel and concrete hangar, 140 ft. square with 28-ft. entrances, and will cost about $55,000. This will be one of seven major structures planned for the site. L. L. Odell will have charge of the construction work.

SOCIETY CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; regional meeting, Pittsburgh, March 18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Norfolk, Va., April 15.

AMERICAN WATER WORKS ASSOCIATION, New York; annual convention, Pittsburgh, Pa., May 25-29.

CENTRAL STATES SECTION, American Water Works Association, has chosen Cincinnati as the place for holding its next annual convention, and the dates selected are Oct. 8 and 9. The program and arrangements are in the hands of Albert S. Hibbs, superintendent of waterworks, Cincinnati, Ohio.

FLORIDA ENGINEERING SOCIETY will hold its fifteenth annual meeting in West Palm Beach March 26-28. The Florida Section, American Society of Mechanical Engineers, the Florida Electrical Engineers and the Florida State Board of Engineering Examiners will hold meetings on the same dates and at the same place. The secretary of the Florida Engineering Society is W. W. Fineren, Gainesville, Fla.

FOUR STATES SECTION, American Water Works Association, will hold its spring meeting March 31 to April 1 in Baltimore. An interesting program is being prepared and inspection trips have been arranged to plants in and near Baltimore of interest of water-works men.

LOS ANGELES SECTION, Sanitary Group, American Society of Civil Engineers, at its February meeting listened to H. A. Jewett, water and sewer inspector, Los Angeles County health department, on "Sanitary Requirements of Swimming Pools"; E. B. Hoag, Beeson Engineering Co., on "Swimming Pool Mechanical Equipment"; and A. M. Rawn, assistant chief engineer, Los Angeles County Sanitation Districts, on "Design of Sludge Digestion Tanks for Los Angeles County Sanitation Districts."

NEW JERSEY SEWAGE WORKS ASSOCIATION will hold its sixteenth annual meeting in Trenton on March 20 and 21. The committee has arranged an interesting program with competent speakers and on the afternoon of the first day there will be round-table discussions of several problems of the sewage-works engineer.

Personal Notes

F. M. TOWNSEND, formerly with the International Railways of Central America and R. W. Hebard & Co., is now general manager of the Pacific Railroad of Nicaragua at Managua.

D. M. FORESTER, chief engineer of the Seabrook Engineering Corporation in its Moscow (U.S.S.R.) office, has recently returned to the United States for a short business visit and vacation. Mr. Forester will return to Russia about the first of April.

EUGENE J. SHAW, formerly with the International Railways of Central America, R. W. Hebard & Co. and A. Guthrie & Co. as chief locating engineer, is at present employed in the same capacity with the Pacific Railroad of Nicaragua.

X. HENRY GOODNOUGH and BAYARD F. SNOW announce the opening of an office in Boston, Mass., for the practice of civil and sanitary engineering, under the name X. Henry Goodnough, Inc. Mr. Goodnough recently resigned as chief engineer and director of the sanitary engineering division of the Massachusetts state department of health. Mr. Snow has been in private practice since last spring, when he completed his work as resident engineer for the South Essex (Mass.) Sewerage Board.

Obituary

GEORGE SERGEANT, JR., retired engineer and contractor, of Philadelphia and New York, died in St. Petersburg, Fla., on Feb. 28. Mr. Sergeant, who was 67 years old, was a graduate of the University of Pennsylvania and had been an engineer in the employ of the Philadelphia & Reading Railroad, the Erie Railroad and the Long Island Railroad.

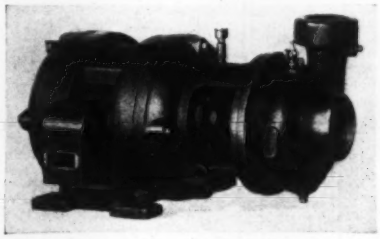
CHARLES EDWARD DODWELL, one of the veteran engineers of the Maritime Provinces, died recently at his home in Halifax, Nova Scotia. Mr. Dodwell was on the engineering staff of the department of public works of Nova Scotia, stationed in Halifax, for 40 years. He was one of the founders of the Canadian Society of Civil Engineers, the predecessor of the Engineering Institute of Canada.

FRANK K. HOOVER, contracting engineer, of Chicago, died on March 6. He was 77 years old. Mr. Hoover, in 1894, associated himself with Arthur J. Mason, civil engineer, forming the firm of Hoover & Mason, to engage in developments connected with excavating and conveying machinery for dredging and mining. The business was removed to Chicago in 1902 and was conducted by Mr. Hoover as sole proprietor after the withdrawal of Mr. Mason in 1910. Notable among the ore docks and conveying machinery constructed by Mr. Hoover are those at Ashtabula and Youngstown, Ohio; South Chicago, Ill., and Sparrow's Point, Md.

Construction Equipment and Materials

Additional Small Pump Units

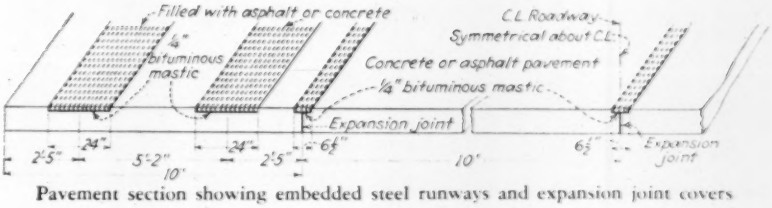
Extension of the line of type SSU centrifugal pumping units of the single-shaft, two-bearing design to cover three new sizes has been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis. In these pumps a single shaft carries both the centrifugal pumping unit and the electric motor which drives it. Ratings are now available for from 30 to 500 gal. per minute for heads under 100 ft. Recent adoption of total inclosure of motor housings on the pump end of the units and totally inclosed fan-cooled motors, when necessary, permits the use of these pumps under severe service conditions.



Direct-connected electric centrifugal pump

Embedded Steel Strips Form Permanent Truck Runways

Believing that much of the wear and tear on modern concrete and bituminous pavements is caused by heavy trucks, Thomas J. Barrett, Bordentown, N. J., has developed and patented a system of highway paving which involves the construction of runways along the right edges of such roads for the use of heavily laden vehicles. The runways consist of tracks formed by embedding metal strips in the asphalt or concrete, the upper edges of the metal strips being notched so that part of the exposed surface is steel and part surfacing material. Details of a typical installation are given in the illustration. While following the general principles outlined, the dimensions can be varied to suit different conditions of surfacing material and density of traffic. In the case of concrete pavement, the steel can well be considered as part of the general reinforcing material and designed as such. The separate strips are tied together by transverse steel rods attached by welding and a special slotted rivet connection to allow for expansion at the end of each section.

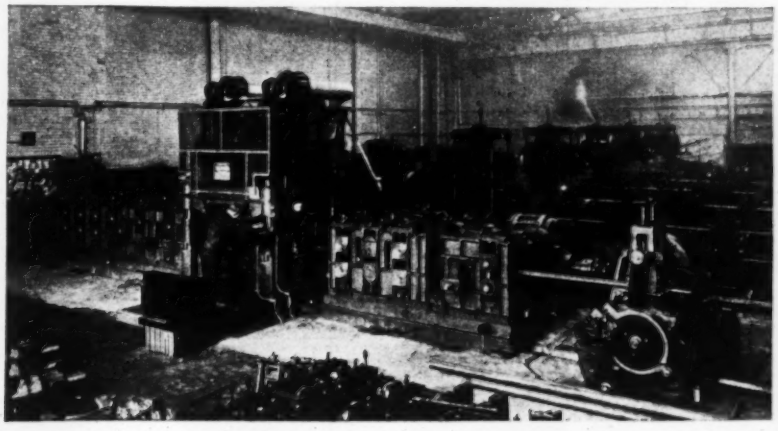


Pavement section showing embedded steel runways and expansion joint covers

When using a bituminous filler with the metal it is possible to prepare precast slabs for the runways, thus simplifying construction on either concrete or bituminous roads. A grouted telford base of extra heavy type is recommended for use under the heavy vehicles. This should be placed in about a 30-in. trench, to a depth of from 8 to 10 in., under each track of the truck runway. Costs are estimated at 9c. to 12c. per square foot for the metal, and 8c. for the bituminous mortar.

Another feature of Mr. Barrett's design is a similar steel strip 6½ in. wide to be used as a cover for expansion joints, serving the dual purpose of preventing entrance of moisture and providing a permanent marking between traffic lanes. A sample section of this type of pavement laid in the city of Trenton, N. J., in 1920 now shows very little wear and is holding up remarkably well, according to Mr. Barrett.

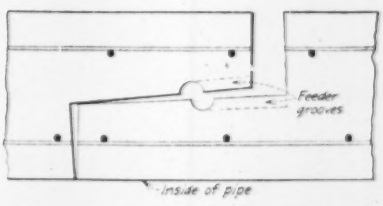
NEW MACHINE FOR WELDING THICK-WALL PIPE



This new electric welding unit is said to increase greatly the range of steel tubing produced by the Republic Steel Corp., Youngstown, Ohio, by the Johnson process. Tubing up to 5 in. in diameter and of much heavier wall thickness than has heretofore been possible is the product. Sizes formerly direct-welded in this manner ranged from No. 26 to No. 11 gage. The new unit welds tubing up to ¼ in. thick and is so constructed that large coils of flat steel stock are fed into the forming rolls to be formed cold into tubes, which pass directly under the electrodes, where fusion takes place without the addition of foreign metal at a speed of approximately 80 ft. of tubing per minute. The welding burr is eliminated and the weld is said to be almost imperceptible. The new machine is also said to permit exceptional uniformity of wall thickness, a tolerance of 0.004 to 0.008 in. plus or minus being usual. The Johnson electric welding process has recently been extended to high-carbon structural tubing by Steel & Tubes, Inc., Cleveland, Ohio, a subsidiary unit of the Republic Steel Corporation.

Asphaltic Joint Seal Developed for Concrete Sewer Pipe

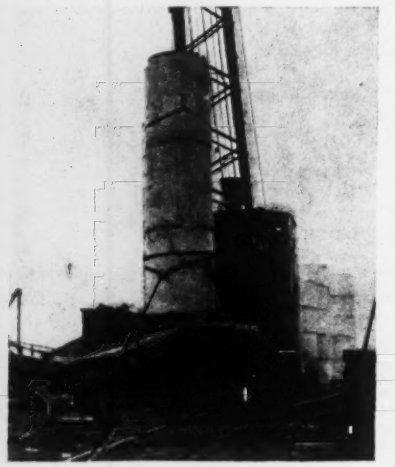
Joint leakage between sections of pipe has been a great source of trouble in sanitary sewer lines, and this fact has probably restricted the use of reinforced-concrete pipe for sanitary sewers. This difficulty appears to have been overcome by the Newark Concrete Pipe Co., 323 Broadway, Newark, N. J., which, in cooperation with Robert Burtnett, of the engineering department of the Westchester County (N. Y.) Sanitary Sewer Commission, has developed a type of joint, illustrated in the sketch, which has shown up very well under hydrostatic and mechanical tests. A test layout of pipe made with this joint and subjected to a head of 20 ft. showed no signs of



Section through concrete pipe joint

leakage. When the head was increased the joints held but the concrete bulkhead cracked, thus bringing the test to a conclusion. The pipe was then transported 35 miles by truck to the plant of the pipe company, where a locomotive crane was used to exert, at first, a 4-ton and later a 7-ton pull on the section. Neither load was sufficient to loosen the joints.

In laying up the pipe, the joints were made by the method illustrated, using a special asphaltic sealing compound developed by Mr. Burtnett. Results of

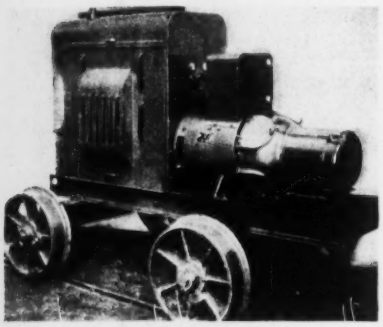


Testing pipe section with locomotive crane

the test were so successful that applications have been made for a patent covering the improvement. Pipes made with this joint and the special sealing compound can both be obtained from the Newark Concrete Pipe Co.

Arc Welder Equipped With Flanged Wheels

A gas-engine driven welding set equipped with flanged wheels for track service is offered by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This Flexarc welder is a 2,000-



Railway-mounted welder

amp., single-operator, self-contained unit, especially suitable for construction work beyond the reach of power lines. The model is available for service on railroad tracks or in mines.

COSTS AND CONTRACTS

E. N.-R. Index Numbers

Cost			Volume		
Mar., 1, 1931	194.51		February,	1931	198
Feb. 1, 1931	196.61		January,	1931	208
Mar. 1, 1930	206.80		February,	1930	204
Average, 1930	202.85		Average,	1930	260
Average, 1929	207.02		Average,	1929	317
1913	100.00		1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of March 12, with some comparisons, total as follows:

(In Thousands of Dollars)

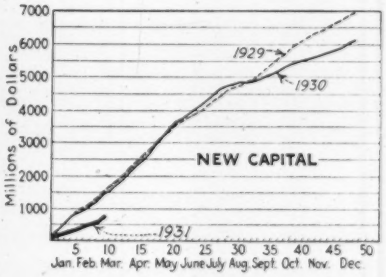
	Mar. 12,	Average of Last Four Weeks	
Buildings:	1931	1931	1930
Industrial	$1,065	$4,156	$6,818
Other	12,947	14,965	31,788
Streets and roads.	12,899	10,319	7,585
Other eng. constr..	10,034	12,889	15,355
Total $36,945		$42,331	$61,547
Total, all classes Jan. 1 to March 12:			
1931 .....$500,209			
1930 548,033			

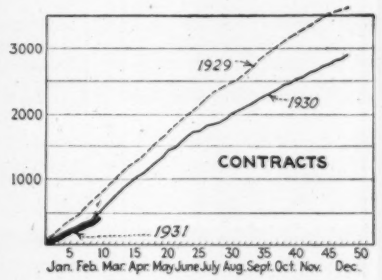
New York City Issue Raises Week's Capital Total

New net capital issued in the week ended March 7 totaled 136 millions, compared with only 46 millions the preceding week and an average of 67 millions for the two months of 1931. Long-term public bonds totaling 112 millions account for this large increase. The principal offering was New York City's 100 millions of corporate stock and serial bonds awarded on 4.134 per cent interest basis. Award was made to Kuhn, Loeb & Co., Dillon, Read & Co., and the International Manhattan Co., all of New York, at a price of 101.977. The city's premium was $1,977,000. The second bid was 101.7077. Private corporation issues totaled 18 millions: 5 industrial and 13 public utilities, compared with an average of 78 millions per week in 1930. Contracts totaled 48 millions, compared with 35 millions the week before, and an average of 46 millions for the year to date.

The ratio of public bonds to total security volume is quite constant, averaging 35 per cent for capital and 39 per cent for contracts. For January, 1931, the percentages were 30 and 49, indicating chiefly a pronounced drop in private financing. Figures for the last three years and for January, 1929-31, are given in millions of dollars per average week in the following table:

	New Capital			Engineering Construction		
Year	Corporation	Public Bonds	Total Securities	Private	Public	Total
1928	72	41	113	42	27	69
1929	86	45	131	50	26	76
1930	78	42	120	34	27	61
Jan.						
1929	68	38	106	60	20	80
1930	83	40	123	27	21	48
1931	55	23	78	24	23	47





New Publications

Car Dumpers—Revolving car dumpers form the subject of a 12-p. illustrated pamphlet issued by the WELLMAN ENGINEERING Co., Cleveland, Ohio.

Surface Mixers—SAM FINLAY, INC., 292 North Ave. N.W., Atlanta, Ga., has issued an illustrated bulletin describing the Fin-Roc surface mixer for the construction of bituminous pavement. Illustrations show the machine at work and typical highways upon which it has been used.

Screens—Advantages of perforated plates for vibrating screens, together with a description of double corrugated square and rectangular mesh for such purposes, are given in a 12-p. bulletin of the HENDRICK MFG. Co., Carbondale, Pa.

Water Treatment—"Recent Developments in Chlorination," a paper by Francis D. West which was read before the last convention of the New England Water Works Association, has been reprinted by the PARADON Co., Arlington, N. J.

Pipe Bending—Principles and practice of bending wrought-iron pipe are clearly outlined in a 10-p. illustrated bulletin 50 issued by the A. M. BYERS Co., Clark Bldg., Pittsburgh, Pa.

Motor Trucks—Results of a nation-wide survey on the use of motor trucks are reported with specific reference to the contracting industry in a 24-p. booklet, "Operating Trucks Profitably in Contracting," published by the GENERAL MOTORS TRUCK Co., Pontiac, Mich. This report summarizes methods used by successful contractors throughout the country for truck management, operation and maintenance and contains many hints which should lead to reduction in trucking costs.

Building Construction—Detail drawings showing methods of erecting ceilings and non-bearing partitions by the Nailock system, a method by which any material commonly used as a plaster base or any standard form of insulation can be nailed to steel studs, are given in an 18-p. illustrated bulletin issued by the WHEELING CORRUGATED Co., Wheeling, W. Va.

Metal-Working Equipment—Tool and shop equipment catalog 30, published by JOSEPH T. RYERSON & SON, INC., Chicago, Ill., contains 158 pages covering practically every type of tool and portable machine used in the metal-working field. Supplies are omitted, the book being devoted entirely to equipment for manufacturers, job shops and contractors.

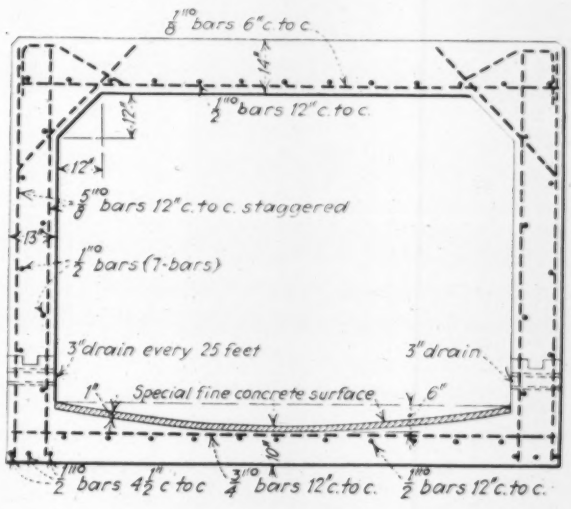
Tractor Equipment—Recent publications issued by the CATERPILLAR TRACTOR Co., Peoria, Ill., include the following: a general catalog of roadbuilding machines; a special catalog on the Caterpillar 60 leaning wheel grader; a booklet discussing the crawler treads used on Caterpillar tractors; and two booklets illustrating the use of tractors in public utility work and in the laying of pipe lines.

Current Construction Unit Prices

Yuba Pass Road, California

BIDS for Sec. E, Shady Flat-Downieville section of Yuba Pass Road, Route 26, Sierra County, California, were opened by C. H. Sweetser, district engineer, U. S. Bureau of Public Roads, San Francisco, on Jan. 20. Lowest three bidders are: A, C. R. Adams, Nevada City (contract); B, Chigris & Sutsos, San Francisco; C, Hemstreet & Bell, Marysville.

	A	B	C
28 acres clearing	$100.00	$150.00	$175.00
148,000 cu.yd. excav., unclassified	.60	.59	.60
295 cu.yd. excav., structure	1.00	1.75	2.00
278,320 sta.yd. overhaul	.02	.03	.03
6,700 cu.yd. crushed rock surfacing	1.90	2.00	1.80
400 cu yd. supplemental crushed rock	1.90	2.00	1.80
400 thousand gallons watering	2.00	3.00	2.50
41 cu.yd. class A conc.	35.00	35.00	35.00
31 cu.yd. class B conc.	35.00	32.00	35.00
3,120 lb. reinforcing steel	.08	.08	.07
282 cu.yd. cement rubble masonry	12.00	15.00	15.00
1,148 lin.ft. 18 in. C.M. pipe in place	2.00	1.75	2.00
226 lin.ft. 24 in. C.M. pipe in place	3.00	2.65	2.50
118 lin.ft. 30 in. C.M. pipe in place	4.00	3.50	3.25
280 cu.yd. hand placed riprap	2.50	5.00	4.00
350 cu.yd. hand placed embankment	2.00	4.00	3.00
136 right-of-way monuments	3.00	3.00	3.50
Totals	$123,159	$128,921	$129,278


1" bars 6" c. to c.
1" bars 12" c. to c.
12"
12"
5/8" bars 12" c. to c. staggered
1/2" bars (7 bars)
3" drain every 25 feet
3" drain
1"
Special fine concrete surface
6"
1/2" bars 4 1/2 c. to c.
3/4" bars 12" c. to c.
1/2" bars 12" c. to c.

Typical section of main sewer

Main Sewer—Reinf.-Conc.	Depth, Ft.	A	B	C
410 lin.ft. 7 ft. 4 in. x 10 ft. 9 in.	9–11	$27.00	$30.50	$28.85
140 lin.ft. 7 ft. 4 in. x 10 ft. 9 in.	11–13	28.00	31.50	29.83
500 lin.ft. 7 ft. x 10 ft. 9 in.	11–13	28.00	28.50	29.55
40 lin.ft. 7 ft. x 10 ft. 9 in.	13–15	28.00	31.00	30.25
160 lin.ft. 6 ft. 8 in. x 9 ft. 3 in.	9–11	25.00	26.75	27.17
260 lin.ft. 6 ft. 8 in. x 9 ft. 3 in.	11–13	26.00	28.00	28.17
870 lin.ft. 6 ft. 6 in. x 9 ft. 3 in.	11–13	25.00	27.00	29.00
185 lin.ft. 6 ft. 6 in. x 9 ft.	9–11	25.00	26.50	27.18
210 lin.ft. 6 ft. 6 in. x 9 ft.	11–13	25.00	27.50	27.91
140 lin.ft. 6 ft. 6 in. x 9 ft.	13–15	28.00	29.00	28.91
Sanitary Sewers—Vitr. Pipe				
280 lin.ft. 8 in.	4– 6	1.50	.90	1.50
2,400 lin.ft. 8 in.	6– 8	2.00	1.25	3.00
240 lin.ft. 8 in.	8–10	2.00	1.40	3.00
850 lin.ft. 12 in.	4– 6	2.00	1.10	1.85
600 lin.ft. 12 in.	6– 8	3.00	1.45	2.85
35 lin.ft. 18 in.	6– 8	3.00	2.10	5.00
165 lin.ft. 18 in.	8–10	3.25	2.60	6.00
Cast-Iron Pipe (Class B)				
150 lin.ft. 6 in.	6– 8	3.00	1.35	2.50
36 lin.ft. 8 in.	4– 6	3.00	1.60	3.00
96 lin.ft. 8 in.	6– 8	3.00	1.75	3.50
24 lin.ft. 12 in.	6– 8	3.50	2.40	5.00
65 lin.ft. 18 in.	8–10	15.00	4.00	8.00
80 lin.ft. 18 in.	10–12	18.00	4.50	10.00
Storm Sewer—Reinf.-Conc. Pipe				
140 lin.ft. 18 in.	0– 4	3.00	2.25	3.50
30 lin.ft. 18 in.	4– 6	3.00	2.35	4.00
120 lin.ft. 24 in.	0– 4	3.50	3.40	4.50
60 lin.ft. 30 in.	6– 8	6.00	4.85	5.00
20 lin.ft. 36 in.	0– 4	7.00	6.00	10.00
50 lin.ft. 36 in.	4– 6	8.00	6.10	12.00
160 lin.ft. 42 in.	4– 6	9.00	7.10	9.00
100 lin.ft. 54 in.	10–12	18.00	12.00	27.50
Totals		$175,895	$177,069	$178,070

State Road in Virginia

DEPARTMENT of highways opened bids Jan. 27 for 11.888 miles of concrete road in Chesterfield County. Ten bids were received, the difference between the lowest and the average being 13 per cent. Unit prices are given of the lowest three bidders: A, G. Y. Carpenter, Chester (contract); B, Spotsylvania Construction Co., Inc., Highland Springs; C, R. K. Williams, Inc., Richmond.

	A	B	C
1 acre clearing and grubbing	$100.00	$200.00	$100.00
26,440 cu.yd. regular excav.	.25‡	.37	.40
7,728 cu.yd. borrow excav.	.25‡	.40	.36
112 cu.yd. conc., class A	18.40	20.00	19.50
137 cu.yd. conc., class B	17.09	18.00	17.00
9,863 lb. metal reinforcement	.034	.05	.05
1,979 lin.ft. wire rope guard rail	.399	.55	.65
1,979 lin.ft. woven wire guard rail	.399	.55	.50
57 conc. right-of-way monuments	1.20	2.00	2.00
1,142 lin.ft. 15-in. pipe	1.15*	1.50*	1.50*
76 lin.ft. 18-in. pipe	1.45	2.00	2.50
108 lin.ft. 24-in. pipe	2.45	3.00	3.00
1,250 lin.ft. 6-in. tile underdrain	.40	.50	.25
9 catchbasins, complete	44.77	30.00	30.00
74,251 sq.yd. cement conc. pavement (7 in.)	1.72	1.69	1.75
5,246 sq.yd. cement conc. pavement (8-6-8 in.)	1.66	1.69	1.75
Totals	$154,265	$157,998	$162,783

* Concrete pipe.

Concrete Sewer and Pipe at Plainfield, N. J.

UNIT prices, received Nov. 3, 1930, are given herewith of a number of items on sec. 2 of the Cedar Brook improvement at Plainfield, N. J. These are: (1) reinforced-concrete main stormwater sewer, sizes 6½x9 ft. to 7¾x10¾ ft., (2) sanitary sewers of 8- to 18-in. vitrified pipe, (3) cast-iron pipe 6- to 18-in., (4) reinforced-concrete storm sewers 18- to 54-in.

Where the ground is sufficiently firm the sewers are laid directly on the bottom of the excavation. Otherwise they are laid on foundations of timber or concrete. Class A concrete, having a 28-day strength of 3,000 lb., is used in the roof of the main sewer and in the sidewalls above the bottoms of the fillets. Class B, 2,500 lb., is used for other purposes except for the reinforced-concrete sewer pipe.

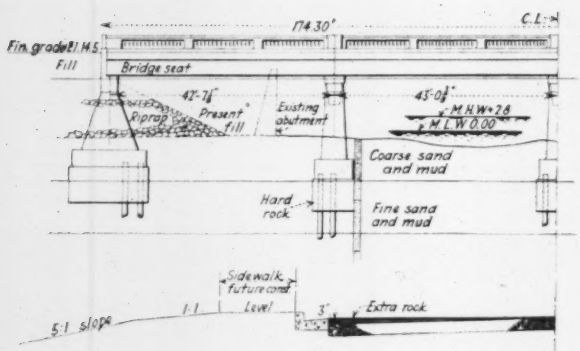
The unit prices in the tabulation are of the lowest three bidders: A, Angelo Paino, 16 Court St., Brooklyn (contract); B, Ralph DeVito, 6314 Dicks Ave., Philadelphia; C, Fabio Matazzo, 1289 Kaighn Ave., Camden.

Concrete Highway Bridge in Florida

IN BREVARD COUNTY, FLA., a four-span concrete highway bridge 174 ft. long, with 30-ft. roadway and two 4½-ft. sidewalks, is being constructed over Crane Creek, near Melbourne, on the site of an existing concrete bridge. Before removing the old bridge a detour bridge was built of timber and piling furnished by the state. When the new structure is completed the detour bridge will be removed, construction and removal being paid for at unit prices bid with 50 per cent allowed for erection.

The existing bridge was removed down to streambed, the concrete being broken up for riprap and placed on the finished slopes of the fill as shown in the drawing. Material is coarse sand and mud underlain with fine shell and sand. The 955 ft. of embankment is hydraulic and is carried to full grade height to a point 4 ft. beyond bridge ends. The slope is 2:1.

Class AA concrete, with 1- or 1½-in. aggregate and 5.2 gal. of water, has a theoretical cement factor of 1.85 bbl. per



Half sections of Crane Creek highway bridge and approach, Florida

	A	B	C
1 acre clearing and grubbing	$100.00	$100.00	$100.00
27,148 cu.yd. hydraulic embank.	0.44	0.50	0.30
2,957 sq.yd. broken stone base No. 2	1.19	1.00	1.23
234 tons extra rock	3.10	2.50	3.00
2,957 sq.yd. single bit. tr. using slag	.40	.33	.24
8 sq.yd. plain cement conc. pavement	3.00	5.00	2.00
2.08 cu.yd. class A conc. for headwalls	26.00	50.00	30.00
348.5 cu.yd. conc. seal	21.00	30.00	44.00
411.9 cu.yd. class AA conc. substructure	25.00	23.00	24.50
458.0 cu.yd. class AA conc. superstructure	25.00	25.00	24.50
Extra depth conc., class AA	27.50	38.00	10.00
Extra depth seal	23.50	45.00	15.00
Extra depth conc., class AA	31.50	48.00	20.00
Extra depth seal	27.50	55.00	25.00
Extra depth conc., class AA	37.00	58.00	25.00
Extra depth seal	33.00	65.00	30.00
360 lin.ft. conc. handrail	3.00	3.00	3.00
153,710 lb. reinf. steel	.048	.425	.045
7,470 lin.ft. untreated founda. piling	.40	.47	.60
292 lin.ft. 18-in. reinf. conc. pipe	3.00	2.00	3.60
292 lin.ft. 18-in. cast-iron pipe	4.00	3.25	4.00
292 lin.ft. 18-in. vit. clay pipe	3.00	2.25	3.60
1,907 lin.ft. conb. cement conc. curb and gutter	1.00	.80	.70
200 lin.ft. woven wire guard rail	2.00	.70	.60
4 catch basins	90.00	125.00	70.00
344 lin.ft. conc. sidewalk	1.00	1.00	1.75
128.0 M.F.B.M. struc. timber, erect. and rem	22.00	20.00	15.00
7,520 lin.ft. trestle piling, erect. and rem.	.30	.30	.30
1 removal of existing bridge	600.00	400.00	1,000.00
275 sq.yd. removal of existing pavement	.30	.40	.20
Totals	$67,704	$69,258	$71,116

cubic yard. Seal concrete, with 1½-in. aggregate and 5.6 gal. water, 1.75 bbl. cement. These concretes are used for the entire structure. Pier columns are given nine coats of waterproofing material and one seal coat from top of footings to El. +4, as are all end bents from top of footings to bottom of beam, the underside and back of beams and backwalls, floor slabs and girders, the unexposed sides of girders and the inside of end walls.

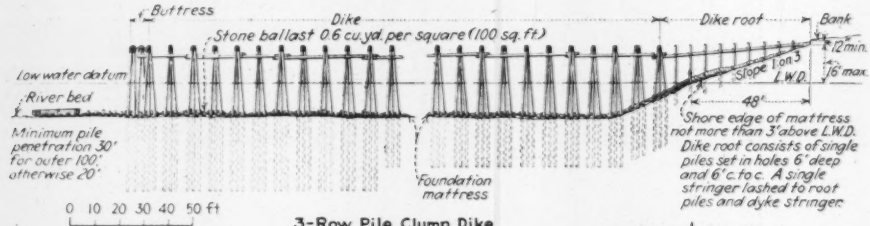
Seven bids were received Nov. 10, 1930, and unit prices are given of the lowest three: A, Okeechobee Construction Co., Okeechobee (contract); B, Olson & Co., Fort Lauderdale; C, Fred D. Beasley, Inc., Tampa.

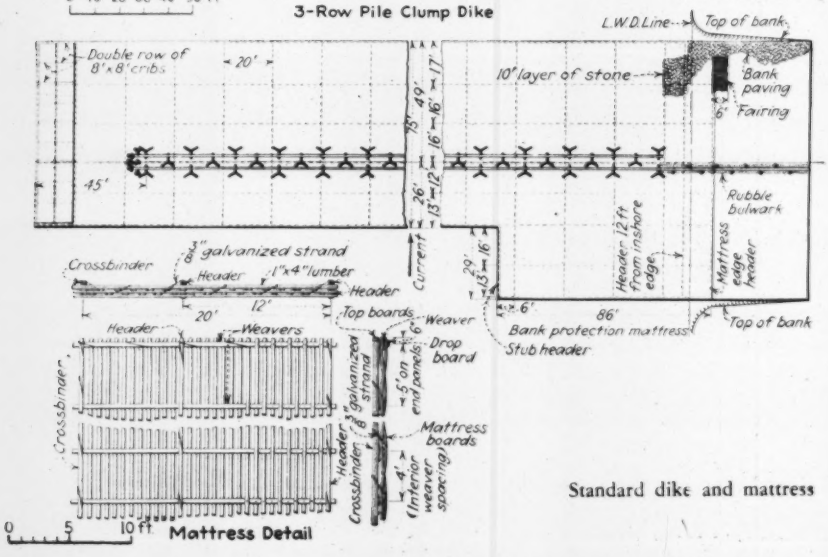
Dikes and Revetments in Missouri River

FOURTEEN standard pile clump dikes 10,650 ft. long and 9,040 ft. of standard revetment are being constructed in the Missouri River at Jackass, Fishing River and Fire Creek Bends, the center of work being 1.7 miles from Sibley, Mo. The dikes consist of 3,975 lin.ft. of the three-row type, with clumps spaced 18 ft., and 6,625 ft. two-row with 15-ft. spacings. The bank end of each dike is protected for a width of 104 ft., 55 ft. above the axis and 49 ft. below, by a lumber mattress 104x86 ft. This is built in conjunction with the foundation mattress and a paved upper bank slope.

Seven contractors furnished estimates, and unit prices are given of the lowest two: A, W. A. Ross Construction Co., 908 West 25th St., Kansas City; B, C. W. Hunter Co., 177 South Front St., Memphis. The work is under the supervision of the U. S. Engineer office at Memphis.

Dike Items	A	B
9,486 squares mattress	$7.90	$8.10
14,817 cu.yd. stone	3.20	3.25
251,243 lin.ft. piles (std.)	.505	.57
245,954 lin.ft. piles (hurdle)	.52	.57
Revetment Items		
7,775 squares mattress	7.90	7.60
22,013 cu.yd. stone	3.45	3.75
9,220 lin.ft. anchor piles	.41	.57
Total, std. piles	$390,379	$415,095
Total, hurdle piles	392,957	413,790


Buttress
Dike
Stone ballast 0.6 cu.yd. per square (100 sq. ft.)
Dike root
Bank
12" min.
16" max.
Slope 1 on 3
L.W.D.
48"
Low water datum
River bed
Minimum pile penetration 30' for outer 100', otherwise 20'
Foundation mattress
Shore edge of mattress not more than 3' above L.W.D. Dike root consists of single piles set in holes 6' deep and 6' c. to c. A single stringer lashed to root piles and dyke stringer
0 10 20 30 40 50 ft
3-Row Pile Clump Dike



Standard dike and mattress

CONSTRUCTION NEWS

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Some of the Week's Large Projects

For further details turn to the appropriate sections in this issue

Location	*Project*	*Cost*	*Status*
Waterworks			
Memphis	Pumping station filtration plant, etc.	$3,000,000	Proposed
Sewers			
Great Neck (N. Y.)	Sewage disposal plant	1,000,000	Proposed
Bridges			
Joliet (Ill.)	Bridges	1,830,000	Proposed
Pittsburgh	Bridge and tunnel	1,687,000	Proposed
Grade Crossings			
Winchester (Mass.)	Grade Crossings etc	3,000,000	Proposed
Subways and Tunnels			
Philadelphia	Subway	5,000,000	Bids asked
Federal Government			
Philadelphia	Federal Court	2,900,000	Proposed
Pittsburgh	Dam	1,196,000	Contract
Ft. Worth	Post Office	1,240,000	Bids asked
Seattle	Hospital	2,000,000	Proposed
Factories and Mills			
Tarentum (Pa.)	Steel Mill	1,500,000	Proposed
Warehouses			
New York	Freight terminal	9,000,000	Proposed
Buildings			
Princeton (N. J.)	Apartment	1,000,000	Contract
New York	Y. M. C. A.	1,000,000	Proposed
Chicago	Nurses' Home	2,350,000	Bids asked
Brooklyn	Nurses' Home, etc	1,625,000	Proposed
New York	Office	10,000,000	Proposed
New York	Office and bank	5,500,000	Contract
New York	Art Museum	3,500,000	Proposed
Bismarck (N. D.)	Capitol	2,000,000	Proposed
Cleveland	Detention Home	1,850,000	Proposed
Perth Amboy (N. J.)	Theatre	1,000,000	Proposed
Worcester (Mass.)	Memorial	2,000,000	Proposed
Cincinnati	Stations, etc.	1,500,000	Contract

WATERWORKS

PROPOSED WORK

Ind., North Vernon — Laying 800 ft. new mains. $15,000. Address City Clerk.

Ia., Urbandale—Waterworks. $15,000. E. T. Archer & Co., 619 New England Bldg., Kansas City, Mo., engrs.

Mass., Amesbury — Town, reservoir at Powow Hill. $100,000. Project in abeyance. Weston & Sampson, 14 Beacon St., Boston, engrs.

Mass., Plainville—Town extending waterworks, improving hys., bridges. $21,300 appropriated.

Mass., Westfield—Town, Bd. Selectmen, waterworks improvements. $87,165.

Mass., Yarmouth—Town, J. E. Howes, water comr. soon takes bids new water system. $75,000. Whitman & Howard, 89 Broad St., Boston, engrs. Noted Feb. 5.

Minn., Redwood Falls — City, F. B. Frobes, clk., preliminary plans water softening plant, reservoir, pump house with pumping equipment. L. P. Wolff, 903 Globe Bldg., St. Paul, engr.

Minn., Two Harbors—City, E. Carlson, clk., 3 m.g. electric and steam-driven pumps for Water Dpt.

N. J., Mantoloking—Ocean County Water Co., Bay Head, additional wells, near pumping station to divert additional 575,000 g.p.d. to increase water supply to Bay Head, Mantoloking and Brick Twps. $15,000.

Tenn., Memphis—Municipality pumping station, mains, filtration plant. $3,000,000. **Maturity about June 1.** Fuller & McClintock, 170 Bway., New York, engrs. Noted Oct. 2.

Texas—Central Power & Light Co., Frost Bldg., San Antonio, 10 in. water line from Gregory to Ingleside to supply water to Humble Refinery plant, at Ingleside.

BIDS ASKED

Calif., Lompoc — Mar. 17, by City Council, furnishing 500 g.p.m. deep well turbine pump with direct connected motor.

Ill., Winnetka — Apr. 7, at office Village clerk, filter plant additions. Pearce, Greeley & Hansen, 9 North Michigan Ave., Chicago, engrs.; adv. E. N.-R. Mar. 12.

Ind., Milton—Mar. 16, by City Council, waterworks improvements. $15,000. C. Ferris, city clk.

N. J., Paterson—Mar. 24, at office Passaic Valley Water Comn., P. L. Troast, secy., 156 Ellison St., 700 ft. c.i. or steel 48 in. connection from Little Falls Pumping Station to Wanaque Aqueduct, Contr. 1: furnishing, delivering 30 in., 36 in. and 48 in. gate valves, Contr. 2: 30 in. pressure regulating valves, Contr. 3: Venturi meter tube, register, accessories, Contr. 4: adv. E. N.-R. Mar. 12.

N. Y., Brooklyn — Mar. 17, by J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, mains in Kings County Hospital grounds; also in Winthrop St., Albany and Clarkson Aves., Brooklyn Boro.

N. Y., Long Island City—Mar. 17, by J. J. Dietz, comr. Water Supply, Gas & Electricity, Municipal Bldg., New York, mains in 24th Terrace, Shore and Traver's Rds., 47th, Goethals, 27th, 49th, 59th, and 81st Aves., 19th, 42nd, 52nd, 68th and 95th, 161st, 163rd, 167th, 206th and 213th Sts., Queens Boro.

N. Y., Rochester — Apr. 1, at office Dpt. Mental Hygiene, F. W. Parsons, comr., State Office Bldg., Albany, elevated tank, pumps, water lines at Rochester State Hospital; adv. E. N.-R. Mar. 12.

S. D., Martin—Mar. 18, by City, 3 mi. c.i. mains, 50,000 gal. elevated tank, well, pump house, pump equipment. $32,000. Dakota Eng. Co., Mitchell, engr. Noted Feb. 19.

Wyo., Evanston—Mar. 16, by City Council, 1 m.g. rein-con. reservoir. $25,000. C. J. Ullrich, Salt Lake City, Utah, engr.

CONTRACTS AWARDED

Conn., New Haven—New Haven Water Co., 100 Crown St., brick, concrete pumping station, Jones Hill Rd., West Haven, to W. H. Crute, 91 Howe St. Est. $15,000.

N. J., Elizabeth—Bd. P. Wks., City Hall, cement lined c.i. supply main, to J. Dominguez, Hasbrouck Heights. $73,224. Est. $90,000. Noted Feb. 19.

N. Y., Maybrook—Bd. Village Trustees, T. A. Miller, clk., general contract water works, to Ward Bros., Suffern, $34,995—pumping equipment, to Worthington Pump & Mchy. Corp., 2 Park Ave., New York, $1,630; pipe contract to Central Fdry. Co., 420 Lexington Ave., New York, $26,943; valves, to Eddy Valve Co., Waterford, $1,946; hydrants and boxes, to Ludlow Valve Mfg. Co., 11 West 42nd St., New York, $2,531; copper service piping, to Chase Brass & Copper Co., 80 Lafayette St., New York, $1,955; elevated storage tank, to Tippett & Wood, 5 Beekman St., New York, $6,946. Grand total $76,946. Noted Feb. 5.

Wash., Seattle—City, pipe line in North and East 80th St., to H. Pederson, 1105 2nd Ave., Hi-tensile c.i. pipe with lead calking. $169,335.

SEWERS

PROPOSED WORK

Ind., Richmond—Bd. P. Wks. revised plans South B Street Sewerage System. $165,000. S. W. Hodgin, Richmond, engr. Noted Oct. 10.

Kan., McPherson—Preliminary plans sewers, $25,000. E. T. Archer & Co., 619 New England Bldg., Kansas City, Mo., engrs.

Kan., Topeka—Soon takes bids 24 and 27 in. vitr. clay sewers in Sewer Dist. 93. $100,000. W. E. Baldry, Topeka, engr.

Mass., Beverly—City, P. Wks. Dpt., sewerage system in Wards 1 and 3. $113,000 appropriated.

Mass., Canton—Town, sewerage system. $50,000. Whitman & Howard, 89 Broad St., Boston, engrs.

Mass., Falmouth — Town sewage disposal plant. $175,000 appropriated. Engineer not selected.

Mo., Springfield—Storm and sanitary sewerage systems. $700,000. S. R. Fisher, Springfield, engr. Noted Feb. 19.

N. J., Allenwood — Bd. Boro Council, Boro Hall, does not plan sewage disposal plant. $50,000. L. Cubberly, 210 Bway., Long Branch, engr. This corrects report published in Feb. 26 issue.

N. J., Ocean City—Bd. City Comrs., City Hall, preliminary plans constructing, extending sanitary sewers in Bayonne Pl., 16th, 17th and 18th Sts. $25,000. W. H. Collisson, Jr., city engr.

N. Y., Great Neck—Village, sewage disposal plant. $1,000,000. **Maturity about May 1 or later.** Fuller & McClintock, 170 Bway., New York, engrs. Noted Dec. 25.

N. Y., Johnson City — Bd. Village Trustees, sewerage system, disposal plant. **Maturity May 1 or later.** Fuller & McClintock, 170 Bway., New York, engrs. Noted Dec. 25.

O., Findlay—City interceptor sewers and sewage treatment plant. $350,000. H. P. Jones & Co., 2nd Natl. Bank Bldg., Toledo, engrs.

Pennsylvania—Board of Engineers consisting of F. Herbert Snow, ch. engr. Public Service Comn., W. L. Stevenson, ch. engr. State Health Dpt., Harrisburg, A. F. Damon, Jr., consult. engr., Sharon Hill, representing 34 municipalities in Delaware County, had surveys made and recommend a joint sewerage disposal system.

Tex., San Marcos—City, c/o Secretary, start surveys and plans about Mar. 1, pumping station, disposal plant. $90,000 voted for same. Montgomery & Ward, Wichita Falls, consult. engrs. Noted Dec. 25.

BIDS ASKED

Ill., Chicago—Mar. 19, by J. J. Sullivan, clk. Sanitary Dist. of Chicago, 910 South Michigan Ave., California Avenue Outfall Sewer, Contr. 1, incl. 4,062 lin.ft. 4 ft. 6 in. internal diam. pre-cast rein.-con. pipe sewer, manholes, 42 ft. outfall structure, miscellaneous work, or 4,044 lin.ft. 8 ft. internal width monolithic rein.-con. sewer, manholes, junction chamber, 21 ft. long, miscellaneous work.

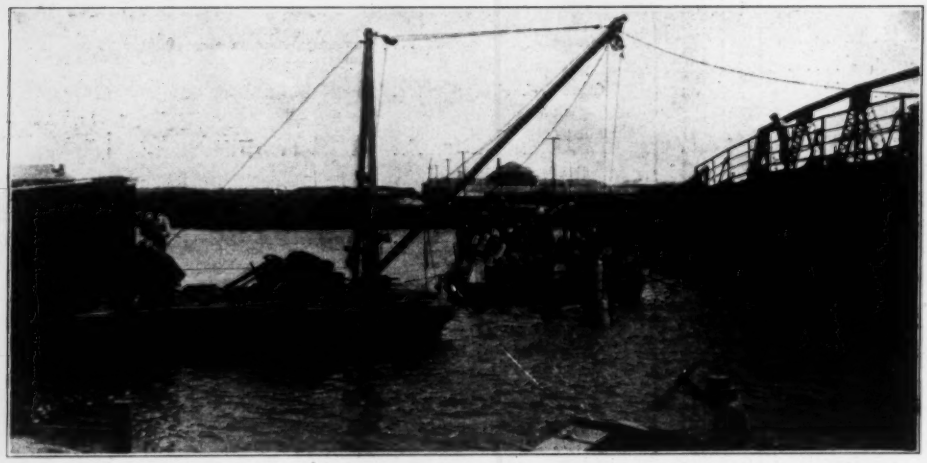
Mass., Boston—Mar. 19, by Metropolitan Dist. Comn., 3,580 ft. 33 x 36 in. and 24 x 27 in. concrete sewer, 30 in. c.i. pipe for Sect. 119.

See proposal advertising on page 113

Const. News page 101

LEADITE

Trade Mark Registered U.S. Pat. Office



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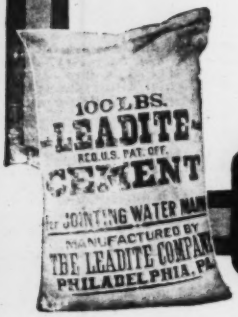

No Caulking

Sewers (Continued)

New Neponset Valley Sewer, South Metropolitan System, in Canton; 5,735 ft. 48 x 51 in. concrete sewer, pipe for 36 in. c.i. pipe siphon, for Sect. 117, New Neponset Valley Sewer, South Metropolitan System, in Norwood. Metropolitan Dist. Comn., 20 Somerset St., engrs.

N. Y., Brooklyn—Mar. 18, by H. Hesterberg, pres. Brooklyn Boro, Boro Hall, sewers in Ocean Ave., Avenue X and Y, Delamere, Elmore, Kenmore and Mansfield Pls., East 96th, East 57th, East 53rd and East 43rd Sts.

N. Y., Central Islip—Mar. 25, at office Dpt. Mental Hygiene, State Office Bldg., Albany, sewers, water lines at Central Islip State Hospital. F. W. Parsons, comr.; adv. E. N.-R. Mar. 12.

R. I., Providence—Sewerage works in Anthony Ave., Aquidneck and Crout Sts. $25,000.

CONTRACTS AWARDED

N. Y., Babylon — Long Island State Park Comn., Administration Bldg., Belmont Lake Park, sewage disposal plant, Jones Beach Park, to Sprague Constr. Co., Arvene, $13,809. Noted Jan. 1.

N. Y., Brooklyn—H. Hesterberg, pres. Brooklyn Boro, Boro Hall, sewers in Vermont Ave., to P. Ribis, $25,557—in East 48th St. to M. Fornara, 173 70th St., $2,085. Noted Feb. 19.

N. Y., New York—H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., sewer in Jerome and Boyd Aves., to C. Turicano Contg. Co., 2911 Coddington Ave., $12,793 and $2,359. Noted Feb. 20 Daily.

WASTE DISPOSAL

PROPOSED WORK

N. J., Englewood—Bd. City Council, Municipal Bldg. municipal garbage incinerator, Linden Ave. west of railroad tracks. $25,000 or more. G. R. Hartley, city engr.

N. J., Irvington (br. Newark)—Town Council, Town Hall, preliminary plans garbage incinerator addition. $150,000. I. J. Casey, town engr.

N. J., South Amboy—Bd. Boro Council, City Hall, municipal garbage incinerator. $25,000 or more. Project in abeyance. Engineer not selected. Noted Feb. 12.

BRIDGES

PROPOSED WORK

Conn., Waterbury — City, Engineering Dpt., City Hall, replacing bridge over Mad River, South Main St. To exceed $25,000. R. A. Cairns, City Hall, engr.

D. C., Wash.—Dist. Comrs., District Bldg., rejected bids Mar. 2, removing existing bridge and constructing bridge across Klingle Valley in line with Connecticut Ave. Noted Feb. 5.

Ill., Chicago—L. M. Thomas, secy. Bd. Comrs. Lincoln Park, and M. E. Connelly, secy., South Park Comrs., and H. E. Young, consult. engr., at office Chicago Plan Comn., 208 West Washington St., bids in March double leaf trunnion bascule bridge over main branch Chicago River, at Outer Dr. improvement crossing. Noted Jan. 27.

Ill., Joliet — Division of Waterways, L. D. Cornish, ch. engr., 220 South State St., Chicago, state seaway work, incl. 175 double leaf bascule, superstructure, 2 ft. roadway, two 9 ft. sidewalks, 161 ft. 4 in. substructures, approaches, McDonough St., $335,000—170 ft. double leaf bascule superstructure, 28 ft. 6 in. roadway, two 8 ft. sidewalks, 205 ft. 9 in. substructure, approaches Jackson St. $345,000—170 ft. double leaf bascule superstructure, 39 ft. roadway, two 10 ft. sidewalks, 150 ft. 8 in. substructure, approaches Jefferson St. $445,000—175 ft. double leaf bascule superstructure, 39 ft. roadway, two 10 ft. sidewalks, 105 ft. 10 in. substructure, approaches, Cass St. $385,000—166 ft. 6 in. single leaf bascule superstructure, 22 ft. roadway, two 8 ft. sidewalks, 186 ft. 3 in. substructure, approaches, Ruby St. $320,000. Superstructures designed by Scherzer Rolling Lift Bridge Co., 53 West Jackson Blvd., substructures, approaches designed by Division of Waterways, L. D. Cornish, ch. engr., 220 South State St.

Ind., Elkhart—Bd. P. Wks., new bridge over Elkhart River, Middlebury St., U. S. Rd. 20 $70,000. F. J. Anderson, Elkhart, engr.

Massachusetts — Commonwealth of Massachusetts, Boston, preliminary plans bridge between Lynn and Revere, at Point of Pines, $850,000. E. H. Rogers, Metropolitan Dist. Comn., Boston, engr. Noted Dec. 19, 1929.

Mass., Abington — Town. Bd. Selectmen, bridges, hys. $42,000 appropriated.

Mass., Barnstable—Town Bd. Selectmen plans bridges, new roads, hys. improvements. $52,500 appropriated.

Mass., Bourne—Town, Bd. Selectmen, bridges, hys. improvements. $46,175 appropriated.

Mass., Concord—Town, Bd. Selectmen, bridges, new roads. $87,600 appropriated.

Mass., Easton—Town. Bd. Selectmen, bridges, new roads. $30,500 appropriated.

Mass., Framingham — Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, and Town, concrete bridge over Sudbury River, Concord St. $25,000. A. W. Dean, Dpt. P. Wks., Boston, engr.

Mass., Franklin — Town. Bd. Selectmen, bridges, hys. improvements. $40,000.

Mass., Hingham — Town, Bd. Selectmen, bridges, hys., improvements, incl. Fore River Bridge. $131,400 appropriated.

Mass., Ipswich—Town, Bd. Selectmen, bridges, hys. improvements. $26,400 appropriated.

Mass., Scituate — Town, Bd. Selectmen, bridges, hys. improvements. $81,650 appropriated.

Mass., Wareham — Town. Bd. Selectmen, bridges, hys. $40,500 appropriated.

Mass., Weymouth — Town, Bd. Selectmen, plans new bridges, roads and hy. improvements. $135,500 appropriated.

Mass., Whitman — Town, Bd. Selectmen, bridges, hys. $31,500 appropriated.

New Jersey—Joint Bd. Comrs., Asbury Park and Ocean Grove, City Hall, bids probably in April, steel, concrete bridge at Emory St. and one at Heck Ave. across Wesley Lake. $40,000. Address Engineer of Asbury Park. Noted Feb. 12.

New Jersey—Bd. Freeholders Middlesex Co., Court House, New Brunswick, steel, concrete bridge over South River between Sayreville and South River. $25,000. Project in abeyance. W. F. Buchanan, Court House, New Brunswick, co. engr. Noted Jan. 22.

N. J., Avon—State Hy. Comn., Trenton, steel, concrete bridge over Shark River. $375,000. **Maturity probably soon.**

Pa., Pittsburgh—Comrs. Allegheny Co. buying bridge and tunnel from Pittsburgh & West Virginia R.R. Co. through Mt. Washington to South Hills, paralleling Liberty Tunnels, and plans reconstructions and improvements, incl. tunnel changes without ventilating system $230,000, ventilating system, lighting system, glazed lining for tunnel $954,000, connecting south end of tunnel with saw mill, Run Blvd. $70,300, bridge flooring $223,400, ramps connecting Pittsburgh end of bridge with Ferry St. and Liberty Ave. $210,000. V. R. Covell, 519 Smithfield St., engr.

BIDS ASKED

California—Mar. 17, by Bd. Directors Joint Highway Dist. 7, Court House, Napa, steel, concrete bridge on Healdsburg-Calistoga Hy., 10 mi. east of Healdsburg, Sonoma and Napa Counties, incl. 476 cu.yd. concrete, 84,700 lb. reinforcing steel, 7,300 cu.yd. excav., also removing old bridge. E. A. Pugh, Court House, Santa Rosa, engr.

D. C., Wash—Mar. 25, by Dist. Comrs., District Bldg., constructing concrete sidewalks, roadway slabs, removing portion concrete jacketed steel floor system, replacing steel work with new concrete jacketed steel beams, placing new concrete sidewalks and roadway slabs on bridge in line New York Ave. over tracks Washington Terminal Co.

Iowa—Mar. 17, by State Hy. Comn., Ames, one 50 x 24 ft., one 40 x 24 ft. I-beam bridges, 22 culverts, extensions, Rd. 67, F.A.B. 317 Black Hawk Co.—one 90 x 20 ft., one 70 x 20 ft. pony truss bridges, 10 culverts, Rd. 65, F.A.B.P. 115 Cero Gordo Co.—90 x 20 ft. pony truss bridge with two 40 x 20 ft. I-beam approach spans, 40 culverts, extensions, Rd. 13, B-236 Delaware Co.—9 culverts, extensions, Rd. 13, B-443—4 culverts, Rd. 13, F.A.B.P. 230, both Linn Co.—8 x 8 ft. twin box culvert, Rd. 65, B-642 Hardin Co.—10 x 10 ft. addition to box culvert, Rd. 31, F.A.B. 162 Woodbury Co. C. R. Jones, aud.

Ia., Orange City—Mar. 20, at office Auditor Sioux Co., 19 concrete box culverts, extensions, concrete floor on I-beam span—also furnishing 27,260 lb. structural steel for twin 28 x 18 ft. VIB.—grading 19,346 mi. 3 projects.

Maryland—Mar. 17, by State Roads Comn., Baltimore, G. C. Uhl, chn., concrete floor for bridge (now under construction), over Monocacy River, Contr. F-172-57, Frederick Co.; slab bridge with sidewalks, fill and surfacing, Contr. P-157-411, Prince George's Co.; adv. E. N.-R. Mar. 12.

Mississippi — Mar. 20, by State Hy. Comn., Jackson, concrete bridge at Station 47 plus 35 on Grenada-Memphis Rd., Grenada Co., incl. 52,086 lb. reinforcing steel, 195 lin.ft. handrail, 1,260 lin.ft. foundation piling. C. M. Williamson, dir.

Missouri—Mar. 14, by State Hy. Bd. Jefferson City, bridges in Audrain, Benton, Christain, Clay, Holt, Marion, St. Louis, Stoddard and Sullivan Counties. T. H. Cutler, ch. engr.

New Jersey — Mar. 23, by State Hy. Dpt., Trenton, bridge carrying Route 4, Sect. 3, over Webster Ave., Bergen Co. A. L. Grover, ch. clk.; adv. E. N.-R. Mar. 12.

Tex., Houston—Mar. 23, by Harris Co., c/o H. L. Washburn, aud., steel, rein.-con. bridge over Simm's Bayou, La Porte Rd. C. R. Hatle, Houston, co. engr.

Virginia—See "Streets and Roads."

CONTRACTS AWARDED

Md., Baltimore—At office City Register, 281 ft. concrete arch bridge over Gwynn Falls and Western Maryland R.R., to W. C. Briddell, 100 North Eutaw St., $109,900. Noted Feb. 19.

New Jersey—State Hy. Comn., Trenton, bridge, approaches over Delaware, Lackawanna and Western R.R., Morris Co., to J. R. Gano, Somerville, $35,843: 4 bridges, Bergen Co., to Bates & Rogers, 75 West St., New York, $285,709; bridge across Hackensack River, Bergen Co., to S. S. Thompson, Red Bank, $321,194. Grand total $642,746. Noted Feb. 19.

Ohio—O. W. Merrell, hy. dir., Columbus, 2 concrete slab bridges, Geauga Co., to D. F. Clark, Mesopotamia, $5,584—three 28 ft. span, concrete slab bridge, 24 ft. roadway, Van Wert Co., to Mauer & Larger, R. R. Fuller, Sidney, $8,740—concrete slab bridge, approaches, Columbiana Co., to J. Hill, Ada, $10,580—24 ft. span concrete slab bridge, approaches, Pike Co., to A. D. Ebersbach, Middleport, $22,927—extending arch bridge, widening roadway, Scioto Co., to Kelley Bros. Constr. Co., Portsmouth, $9,893—concrete arch bridge, Erie Co., and five 70 ft. span steel beam bridge, 30 ft. roadway, Hancock Co., to Dodge-Hussey Co., 1174 West 5th Ave., Columbus, $49,906 and $70,549 respectively 40—ft. span, concrete beam bridge, 24 ft. roadway, Wyandot Co., to Seneca Constr. Co., Fostoria, $16,410—24 ft. span, reinforced slab bridge, 24 ft. roadway and approaches, Knox Co., 55 ft. span concrete beam bridge, 24 ft. roadway, culvert and approaches, Perry Co., to S. Renick & Son, Mt. Sterling, $12,050 and $13,912 respectively—2 concrete beam bridges, one 30 ft. span and other 45 ft. span, 24 ft. roadway, Knox Co., to J. R. Board, Alexandria, $4,570—three 50 ft. span, concrete beam bridge, 24 ft. roadway and two 3 ft. sidewalks, Jefferson Co., to C. H. Rice & Sons, Belmont, $32,522—30 ft. span, concrete beam bridge, 24 ft. roadway, Logan Co., to J. Frantz, Sidney, $12,328—110 ft. span, concrete arch bridge, 31 ft roadway, Lorain Co., to C. T. Moore, 13494 Lee Rd., Shaker Heights, $36,343—115 ft. span, steel truss bridge, 24 ft. roadway, Wood Co., to J. H. Jones & Son, Fostoria, $22,555—75 ft. span steel truss bridge, 30 ft. roadway, Washington Co., to Bellefontaine Development Co., Bellefontaine, $20,985. Grand total $349,854. Noted Feb. 12.

Tex., Houston — City, rein.-con. and steel suspension bridge over Buffalo Bayou, McKee St., to Don Hall Constr. Co., Union Natl. Bank Bldg., $122,000 est. $100,000. Noted Jan. 29.

Tex., Houston—Harris Co., c/o H. L. Washburn, aud., 4,464 ft. steel, timber, and rein.-con. bridge over Tabbs Bayou, Goose Creek to Morgan Point Rd., to Dodds & Wedegartner, San Benito, $123,000. Noted Feb. 5.

Washington—State Hy. Comn., Olympia, bridge over Touchet River, Waitsburg, Walla Walla Co., to F. E. and H. Lockyear, 2069 Thompson St., Portland, Ore., $23,256; rein.-con. bridge at 26th and B Sts., Tacoma, Pierce Co., to G. Milton Savage Co., 401 East 11th St., Tacoma, $60,106.

Que., Hull — Dpt. Hys., Quebec City, substructure new bridge over Gatineau River at Gatineau Point to Lambert, Foley & Grant, Hull, $111,000; superstructure to Steel Dominion Bridge Co. Ltd., Ottawa, Ont., $95,000. Noted Nov. 13.

STREETS AND ROADS

BIDS ASKED

California—Mar. 25, by C. H. Purcell, engr. State Hy. Comn., Sacramento, grading, concrete surfacing 11.1 mi. road between point 2 mi. north of Salinas and northern boundary, Monterey Co.—grading, oiling 7.5 mi. Rileys Ranch-Neenach School, Los Angeles Co.—concrete surfacing 8.8 mi. road between La Posta Creek-Campo Road Junction, San Diego Co.

Calif., Long Beach—Mar. 20, by City Council, curbing, guttering, 111,290 sq.ft. sidewalks on Jackson St. between Orange and Cherry Sts.

Calif., Los Angeles—Bd. P. Wks., City Hall, rejected bids grading, curbing, sidewalks, 6 in. concrete paving, using expansion joints, 240,000 sq.ft. 112th St. and Bellhaven Street Improv. Dist. Will readvertise. Noted Feb. 26.

Illinois—Mar. 25, by Dpt. P. Wks. & Buildings, Div. Hys., Springfield, widening to 20 ft., 2½ in. brick resurfacing 1.07 mi. road from La Salle east, Routes 2 and 7-A, Sect. C-RS, Dist. 3 La Salle Co.—0.43 mi. Springfield Rd., Route 4, Sects. L-RS and D-RS, Dist. 18 Sangamon Co.—10.05 mi. Mitchell-Hamel Hy., Route 4, Sect. 65-RS, Dist. 8 Madison Co.—5.83 mi. Troy Rd., Route 11, Sect. 47-RS, Dist. 8 Madison Co. — 2 mi. Hamel-Staunton Hy., Route 4, Sect. 66-RS, Dist. 8 Macoupin Co.—7.52 mi. DeKalb-Ogle Co. Line Rd., Route 6, Sect. 34-RS, Dist. 1 De Kalb Co.—1.99 mi. Ottawa Rd., Route 7, Sect. G-RS, Dist. 3 La Salle Co.—3.01 mi. Bartonsville-Orchard Mines Rd., Route 9, Sect. 46W-RS, Dist. 15, 1.4 mi. Peoria Heights Rd., Route 88, Sect. 126-RS, Dist. 15, both Peoria Co.—8.07 mi. Marshall-Indiana State Line Rd., Route 11, Sect. 46-RS, Dist. 5 Clark Co.—6.32 mi. Viola-Grays Lake Rd., Route 20, Sect. 16-RS, Dist. 1 Mercer Co.—3.12 mi. St. Charles-South Elgin Rd., Route 22, Sect. 22-RS, Dist. 1 Kane Co.—5.24 mi. Chicago Heights Rd., Route 22, Sect. 23-RS Dist. 1 Cook Co. — 6.28 mi. Waukegan Lake Bluff Rd., Route 42-A, Sect. 43-RS, Dist. 1 Schuyler and Lake Counties. F. T. Sheets, hy. engr.

Ill., Galesburg—Mar. 14, by State Aid Roads Comn., Knox Co., furnishing, unloading, hauling, spreading 42,000 sq.yd. gravel on 6 mi. State Aid Route 8—22,000 sq.yd. on 3 mi. State Aid Route 1-D, Sect. M-MFT—44,500 sq.yd. on 6 mi. State Aid Route 8, Sect. S-1-B-MFT—grading 6 mi. State Aid Route 8, Sect. 1-A-MFT A. R. Smith, Galesburg, engr.

Ind., Valparaiso — Mar. 21, by Bd. Comrs. Porter Co., gravel surfacing 3.998 mi. J. F. Bedenkop, H. F. Black and C. J. Gut Rds. $40,447. C. A. Blackly, Valparaiso, aud.

Iowa—Mar. 17, by State Hy. Comn., Ames, grading, drainage structures, flumes, paving 4.809 mi. Rd. 9, P-685-B—16.639 mi. Rd. 9, P-677, both Allamakee Co.—4.722 mi. Rd. 30 F-328 Boone Co.—13.871 mi. Rd. 18, P-259 Clay Co.—10.008 mi. Rd. 13, P-236 Delaware Co.—9.384 mi. Rd. 13, P-443 Linn Co.—22.11 mi. Rd. 9, P-725-A, B, C, D—11.8 mi. Rd. 9, P-725-A, both Osceola Co.—grading 7.388 mi. Rd. 99, P-698-B Jackson Co.—8.3 mi. Wellington Rd., P-543 Washington Co. C. R. Jones, aud.

Ia., Adel—Mar. 12, at office Auditor Dallas Co., grading 22.5 mi. roads.

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Streets and Roads (Continued)

Ia., Cedar Rapids—Mar. 19, at office Auditor Linn Co., resurfacing 20.5 mi. county trunk roads, 0 mi. local roads, crushed stone surfacing 1,000 cu.yd. Sect. Dist. 24.

Ia., Orange City—See "Bridges."

Ia., Primghar—Mar. 19, at office Auditor O'Brien Co., grading, incidental work 15.45 mi. county trunk roads, 4 mi. local roads.

Ia., Toledo—Mar. 18, at office Auditor Tama Co., grading, drainage structures, grubbing, incidental work 26.6 mi. county trunk and local roads; also 120,000 gal. gasoline, 100 bbl. lubricating oil, 10,000 lb. grease.

Kansas—Mar. 16, by State Hy. Comn., Court House, Iola **(P. means Project and F.A.P. Federal Aid Project)** grading, culverts 0.614 mi. P. 73-W-11, F. A. P. 21-C Allen Co., incl. seven 30 ft. deck girder spans — 1.044 mi. P. 6-7, F. A. P. 328-E, 4.172 mi. P. 6-8, F. A. P. 339-C—4.994 mi. P. 38-1, F. A. P. 339-D, incl. 3 multiple box spans, all Anderson Co.—2.794 mi. P. 38-2, F. A. P. 339-E, incl. 3 multiple box spans, Linn Co. — 0.521 mi. bridge approaches. P. 73-W-10, F. A. P. 334-C Neosho Co.—0.482 mi. P. 166-9, F. A. P. 384-C Montgomery Co., incl. 130 ft. concrete arch span bridge—chats surfacing 3 mi. P. 3-8, Kansas Project 1146 Linn Co.—1.772 mi. P. 73-E-5, F. A. P. 73-D Cherokee Co.—concrete surfacing 2.676 mi. P. 73-W-12, F. A. P. 283-A Allen Co. — gravel surfacing 2 mi. P. 57-17, Kansas Project 1150 — oil and light type surfacing 6.556 mi. P-75-11, F. A. P. 418-B—1.036 mi. P. 75-11, Kansas Project 1087—3.499 mi. P. 75-11, F. A. P. 418-A, all Woodson Co.—chats surfacing 4 mi. P. 38-5, Kansas Project 1151 Bourbon Co.—7 mi. P. 73-W-5 Kansas Project 7267, Labette Co.—9 mi. P. 39-6, Kansas Project 7260 Neosho Co.—10 mi. P. 68-3, Kansas Project 7263—7 mi. P. 68-4, Kansas Project 7264, both Miami Co.—4 mi. P. 96-37, Kansas Project 7265, Montgomery Co. W. V. Buck, Topeka, hy. engr.

Kansas—Mar. 18, by State Hy. Comn., Court House, Liberal **(P. means Project and F.A.P., Federal Aid Project)** grading culverts 0.151 mi. P. 50-4, F. A. P. 338-G, incl. 25 ft. slab span bridge—1.763 mi. P. 50-4, F. A. P. 338-E, incl. 25 ft. slab span bridge—0.95 mi. P. 50-3 and 4, F. A. P. 338-F, incl. 25 ft. slab span bridge, all Kearney Co.—1.317 mi. P. 50-1, F. A. P. 422-A, incl. three 10 ft. multiple box spans—20.84 mi. P. 50-1 F. A. P. 422-C, incl. four 30 ft. deck girder spans — 0.294 mi. P. 50-1, F. A. P. 422-B, incl. five 30 ft. deck girder spans — 0.473 mi. P. 50-2, F. A. P. 338-D, incl. three 30 ft. deck girder spans—repairing bridge floor P. 37-6, Kansas Project 1153, all Hamilton Co.—grading, culverts, oil and light type surfacing 13.831 mi. P. 45-3B, F. A. P. 433-A Stevens Co.—1.747 mi. P. 54-2, F. A. P. 369-C—4.542 mi. P. 54-3, F. A. P. 369-D—oil and light type surfacing 6.499 mi. P. 54-2, F. A. P. 153-A all Seward Co.—grading, culverts, light type surfacing 7.766 mi. P. 27-1, F. A. P. 358-B Morton Co., incl. seven 8 ft. multiple box spans — repairing bridge floor P. 27-2, F. A. P. 358-A Morton Co. W. V. Buck, Topeka, hy. engr.

Kansas—Mar. 20, by State Hy. Comn., Court House, Winfield **(F.A.P. means Federal Aid Project)** concrete surfacing 3.485 mi. P. 77-4, F. A. P. 230-B — 3.647 mi. P. 77-3 and 4, F. A. P. 230-A—3.879 mi. P. 77-3 F. A. P. 230-F — 0.134 mi. P. 77-3 and 4, F. A. P. 230-D — grading, culverts 6.902 mi. P. 166-3, F. A. P. 356-H—grading, culverts 8.193 mi. P. 166-3, F. A. P. 356-I, incl. six 30 ft. and three 35 ft. deck girder spans, all Cowley Co.—4.837 mi. P. 50-S-23, F. A. P. 399-E Harvey Co.—9.878 mi. P. 50-N-14, F. A. P. 331-F, incl. three 7 ft. and five 8 ft. multiple box spans, six 16 ft. slab spans, five 35 ft. deck girder spans—0.528 mi. P. 50-N-14, F. A. P. 3-D—9.477 mi. P. 50-N-14, F. A. P. 131—all Barton Co.—3.325 mi. P. 96-25, F. A. P. 396-A, incl. three 7 ft. and four 10 ft. multiple box spans—11.741 mi. P. 96-25, F. A. P. 396-B, incl. three 7 ft. multiple box spans, both Butler Co.—five 16 ft. slab spans, P. 81-6, F. A. P. 24-A, Sedgwick Co. W. V. Buck, Topeka, hy. engr.

Kentucky — Apr. 15, by State Hy. Dpt., Frankfort, grading, drainage structures 3.4 mi. Blackmont-Alva Rd. (Pucketts Creek Rd.) from Blanchmont to Harlan Co. line, Bell Co.—8.7 mi. Liberty-Somerset Rd. from Liberty to Pine Grove School, Casey Co.—8.3 mi. Marion-Shady Grove Rd. from Marion to Deanwood, Crittenden Co. — 7.4 mi. Peonia-Brownsville Rd. from Peonia to Edmonson Co. line, Grayson Co.—4.1 mi. Covington-Morning View Rd. from Covington South, Kenton Co. — 4.1 mi. Covington-Morning View Rd. from Covington to De Coursey Creek Bridge, Kenton Co.—6.3 mi. Salem-Goleonda Rd. from Salem to Lola, Livingston Co. — 6.7 mi. Richmond-Paint Lick Rd. from Caleast to Paint Lick, Madison Co.—surfacing 9 mi. Leitchfield-Beaver Dam Rd. from Caneyville to Ohio Co. line, Grayson Co.—14.9 mi. Greenville-Kirkmansville Rd., Muhlenberg and Todd Counties—15.2 mi. Beaver Dam-Leitchfield Rd. to Hartford, Ohio Co. — 6.6 mi. Hazard-Jackson Rd. from Hazard to Dwarf, Perry Co. —3.1 mi. Hazard-Whitesburg Rd. from Hazard to Glomar, Perry Co.—10.5 mi. Stanford-Mt. Vernon Rd. from Stanford to Crab Orchard, Lincoln Co.—grading, drainage structures, surfacing 1 mi. approaches to overhead crossing on Bowling Green-Glasgow Rd., Warren Co.—bridge structures, grading approaches 0.5 mi. bridge over Beech Fork, Springfield-Perryville Rd., Washington Co. B. Johnson, chn.

Maine—Mar. 17, by State Hy. Dpt., Augusta, gravel surfacing 6.15 mi. hy. Kenduskeag and Corinth; bituminous macadam paving 0.9 mi. hy. Norridgewock.

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Maryland—Mar. 17, by State Roads Comn., Baltimore, G. C. Uhl, chn., concrete paving 2.2 mi. Federal Aid Project 232-A, Contr. Co-66-22, Caroline Co.; 7.8 mi. Federal Aid Project 227-A, Contr. 165-611, Frederick Co.—macadam resurfacing 1.25 mi. Contr. Ho-90-52, Howard Co.; adv. E. N.-R. Mar. 12.

Md., Baltimore — Mar. 18, by Bd. Awards, vitr. brick paving 1,100 sq.yd. and granite block paving 2,750 sq.yd. streets listed in Contr. 588; sheet asphalt paving 17,300 sq.yd. streets listed in Contr. 589. N. L. Smith, Municipal Bldg., hys. engr.

Mass., Boston—Mar. 18, by Dpt. P. Wks., J. A. Rourke, comr., sheet asphalt or bituminous macadam paving approach to Prison Point Bridge. $25,000.

Mich., Bay City—Mar. 20, by Bay Co. Rd. Comn., shaping, grading, drainage structures, concrete paving 2.5 mi. Portsmouth Rd., and 2 mi. Pinconning Rd. L. J. Weingartner, Bay City, co. engr.

Mississippi — Mar. 20, by State Hy. Comn., Jackson **(F.A.P. means Federal Aid Project)** clearing, grubbing, grading, drainage structures, bridges, 3.956 mi. Tupelo-New Albany Rd., F. A. P. 169-B, Lee, Pontotoc and Union Counties, incl. 148,454 lb. reinforcing and 93,060 lb. structural steel, 2.64 mi. Bermuda sodding, 228 lin.ft. concrete and steel handrail, 294 lin.ft. foundation piling—5.072 mi. Jackson-Star Rd., F. A. P. 200-D, Rankin Co., 148,477 lb. reinforcing steel, 2.7 mi. Bermuda sodding, 348 lin.ft. handrail, 2,268 lin.ft. foundation piling — 8.673 mi. Hazelhurst-Wesson Rd., F. A. P. 89-A, Copiah Co., 120,459 lb. reinforcing steel, 4.4 mi. Bermuda sodding—6.238 mi. Star-D'Lo Rd., F. A. P. 200, Simpson Co., 111,620 lb. reinforcing steel, 3.4 mi. Bermuda sodding, 195 lin.ft. handrail, 1,260 lin.ft. foundation piling—grading, clearing, grubbing, bridges, drainage structures, concrete, sheet asphalt, asphaltic concrete or rock asphalt surfacing 5.515 mi. Holly Springs-Olive Branch Rd., F. A. P. 94—Reopened 189-B, Desota Co., 125,491 lb. reinforcing, 4.46 mi. Bermuda sodding, C. M. Williams, dir.

Missouri—Mar. 14, by State Hy. Bd., Jefferson City, grading, graveling, concrete or crushed stone paving roads in Andrew, Audrain, Barry, Benton, Caldwell, Christian, Clay, Dallas, Holt, Johnson, Marion, Monroe, Osage, St. Louis, Stoddard, Stone, Sullivan and Washington Counties.

N. J., Cliffside Park—Mar. 16, by Bd. Boro Council, Boro Hall, grading, sheet asphalt on concrete paving Prospect, Rothwell and Riverview Aves. $25,000. McClave & McClave, boro engrs.

N. J., East Orange—Mar. 23, by City Council, City Hall, sheet asphalt on present telford base, 2 in. national or 2 in. warrenite bitulithic paving North Clinton St. from Hamilton St. to Springdale Ave. $25,000. W. Willigerod, city engr.

N. J., Middletown—Mar. 26, by Twp. Com., H. W. Roberts, clk., reconstructing Wilson Ave. and Main St., New Monmouth and Port Monmouth, Allen & Randolph, 60 Broad St., Red Bank, civil engrs.; adv. E. N.-R. Mar. 12.

N. J., New Brunswick—Mar. 20, by Bd. Freeholders Middlesex Co., concrete paving 1.47 mi. Woodbridge-Iselin-Oak Tree Rd., W. F. Buchanan, Perth Amboy, co. engr.

New York—Mar. 27, by A. W. Brandt, comr. Hys., Albany, constructing hys. in Chautauqua, Suffolk and Montgomery Counties—reconstructing hys. in Broome, Cayuga, Chemung, Tioga, Erie, Essex, Niagara, Schoharie and Albany Counties; adv. E. N.-R. Mar. 12.

N. Y., Delhi—Mar. 26, by W. J. Howland, supt. Hys., Delaware Co., Court House, bituminous macadam, penetration method, imported lime stone paving 6.37 mi. Delhi-Treadwell Rd., Project 13; adv. E. N-R. Mar. 12.

N. Y., New York—Mar. 16, by S. Levy, pres. Manhattan Boro, Municipal Bldg., grading, granite block on concrete paving roadway 40 ft. wide through present safety isle, Manhattan Bridge Plaza at Canal St., east of Bowery; 9th Ave., Franklin, Jacob, and Gold Sts.; grading, sheet asphalt on concrete paving Lexington Ave. and Pine St.

N. Y., St. George—Mar. 18, by J. A. Lynch, pres. Richmond Boro, Boro Hall, bituminous macadam paving Maple Parkway, St. Joseph's and Morrison Aves.

O., Dayton—Mar. 19, by Comrs Montgomery Co., Court House, furnishing, placing 250,000 sq.yd. tar surface treatment and 100,000 sq.yd. asphalt penetration treatment for gravel roads in county. $40,000. W. O. Pease, Court House, co. surv.

O., Shaker Heights (br. Cleveland)—Mar. 24, by City of Shaker Heights, grading, drainage structures, curbing and paving East Belvoir, West Belvoir Ovals, Fayette Rd. and South Park Blvd. $100,000. Former bids rejected. F. A. Pease Eng. Co., Terminal Tower, Cleveland, engrs.

Pa., Phila. — Mar. 24, by Bureau of Hys., Schedule A, grading H St. from Ramona St., to point 100 ft. north of Cayuga, Whitaker St. from Erie to Luzerne Sts. — Schedule B, reconstructing, repaving deck of Walnut Street Bridge over Schuylkill River — Schedule C, county road improving Bean St. from Shawmont to Minerva Sts., Eva St. from Shawmont to Dearnley Sts., Minerva St. from Eva to Bean Sts., Cheltenham St. from Weymouth to Newton Sts.—Schedule D, concrete paving Upsur St. from New Market St. to point 173 ft. east—Schedule E, repairs to fender Passyunk Avenue Bridge over Schuylkill River—Schedule F, furnishing, applying bituminous material (dust laying oil).

R. I., East Providence—Mar. 16, by Town Council, granite curbing as follows: 7,000 lin.ft. straight, 180 ft. 10 ft. radius, 86 driveway corners; 700 sq.yd. granite block paving; 225 cu.yd. excav., and 820 sq.yd. bituminous macadam paving.

S. D., Sioux Falls—Mar. 23, by Bd. City Comrs., at office W. C. Leyse, aud., concrete paving 1,440 sq.yd. Walts Ave.; 7,102 sq.yd. 3rd St.

Tex., Big Springs—City, c/o J. R. Smitham, city mgr., rejected bids grading, concrete curbing, guttering, alternate types paving 31,000 sq.yd. $50,000. Noted Feb. 12.

Tex., Corpus Christi—G. Blackburn, city engr., and City Comn., bids about Mar. 18, curbing, guttering, base and hardsurfacing, 12 blocks Tiger and Galivan Sts. $44,245.

Tex., Sinton—Mar. 20, by C. Houts, judge San Patricio Co., Court House, grading, drainage structures, caliche base top course paving Sinton-Adams School House Rd. J. M. Winfrey, Sinton, engr.

Virginia—Mar. 17, by State Hy. Dpt., Richmond **(R. means Route and P. Project)** clearing, grubbing, grading, drainage structures, macadam surface treatment 3.2 mi. Lynchburg Rd., R. 14, P. F-7-AR—2.5 mi. same road, R. 18, P. F-688-A, both Campbell Co.—grading, drainage structures, concrete and macadam sheet asphalt surfacing 2.6 mi. Halls Hill-Falls Church Rd., R. 21, P. F-314-W Arlington Co. — grading, drainage structures, cold bituminous surfacing 1.4 mi. Solomons Store-Brook Run Rd., R. 31, P. F-575-D Henrico Co. — clearing, grubbing, grading, drainage structures 2.8 mi. Hibbetts Hill Rd., R. 122, P. F-494-D Wise Co.—span 30 ft. rein.-con. beam and 150 ft. steel truss span bridge over Rivanna River, at Palmyra, R. 32, PF-493-B Fluvanna Co. H. G. Shirley, hy. engr.; adv. E.N.-R. Mar. 12.

Va., Richmond — Mar. 16, at office R. K. Compton, dir. P. Wks., alternate types paving 18,225 sq.yd. streets; brick on 6 in. concrete paving 4,300 sq.yd. 17th St.; adv. E. N.-R. Mar. 12.

Wisconsin — Mar. 17, by State Hy. Comn., and Committees Taylor, Pierce, Eau Claire, Trempealeau, Pepin, Dunn and St. Croix Counties, 213 South Barstow St., Eau Claire, grading, culverts, 12.99 mi. Medford-Prentice Rd., Taylor Co. — grading, concrete surfacing 3.81 mi. Ellsworth-Plum City Rd., Pierce Co.—concrete paving 7.891 mi. Osseo-Eau Claire Rd., Eau Claire and Trempealeau Counties—10.253 mi. Osseo-Eau Claire Rd., Eau Claire Co.—grading, culverts, bridging, crushed stone surfacing 3.53 mi. Ellsworth-Durand Rd., Pepin Co. — grading, bridging, shale surfacing 2.696 mi. Menomonie Wheeler Rd., Dunn Co.—constructing Apple River Bridge, St. Croix Co.

Wisconsin—Mar. 20, by State Hy. Comn., and Committees, Grand and Lafayette Counties, Court House, Lancaster, grading, culverts 0.93 mi. Dubuque-Platteville Rd.—3.03 mi. Mount Ida-Fennimore Rd.—2.185 mi. Mount Ida-Bridgeport Rd. — crushed stone surfacing 10.75 mi. Fennimore-Bridgeport Rd. — 12.54 mi. Fennimore-Bridgeport Rd., Job 2—15.21 mi. Platteville-Lancaster Rd., Job 4 — 10 mi. Lancaster-Union Rd. — 15.5 mi. Platteville-Montfort Rd., all foregoing in Grant Co. — grading 60,564 cu.yd. Warren-Gratiot Rd., Lafayette Co.

Wisconsin—Mar. 19, by State Hy. Comn., and Committees Jackson, Monroe, Trempealeau, and LaCrosse Counties, Court House, LaCrosse, grading, shale surfacing 6.7 mi. Black River Falls-Tomah Rd., Jackson Co. — grading 10.25 mi. Middle Ridge-LaCrosse Rd., LaCrosse Co.—grading, shale and pea gravel surfacing 3.82 mi. Eleva-Strum Rd., Trempealeau Co. — crushed stone surfacing 6 mi. Viroqua-Prairie du Chien Rd., Vernon Co.—fine crushed stone surfacing 19.45 mi. Ontario-Hillsboro-Union Center Rd., Vernon Co.

Wyoming — Mar. 17, by State Hy. Comn., Capitol, Cheyenne, grading, culverts on 9.177 mi. Sheridan-Gillette Rd., F.A.P. 66-C, Campbell Co.—grading, bridges on 6.717 mi. Cody-Powell Rd., F.A.P. 103-D, Park Co.—18.566 mi. Casper-Shoshoni Rd., F.A.P. 168-D, Natrona Co. — 9.077 mi. Casper-Shoshoni Rd., F.A.P. 195-C, 15.861 mi. Shoshoni-Casper Rd., F.A.P. 195-B, both Fremont Co.—8.499 mi. Kaycee-Midwest Rd., F.A.P. 189-E, Johnson Co. — oil treated gravel surfacing 12.875 mi. Sheridan-Buffalo Rd., F.A.P. 178-B and C, 143-A and B, and State Projects 880 and 884 combined, and 32.019 mi. Sheridan-Buffalo Rd., Sheridan and Johnson Counties—oil treatment by road mix method 26.58 mi. Midwest-Kaycee Rd., F.A.P. 189-D and 189-C 30 and State Project 874, Johnson and Sheridan Counties — bituminous macadam paving 0.854 mi. Angus Street and Gillette Ave., in town of Gillette, F.A.P. 120-D.

CONTRACTS AWARDED

Ariz., Winslow—Curbing, guttering, paving 49.5 city blocks, to Southern California Roads Co., 530 West 6th St., Los Angeles, Calif., $111,093. Est. $130,000.

California — State Hy. Comn., Sacramento, grading, concrete paving 7.7 mi. road between Stockton and point 0.5 mi. north Houston School, San Joaquin Co., to Jahn & Bressi, Lane Mortgage Bldg., Los Angeles, $249,598. Noted Feb. 5.

D. C., Wash.—Dist. Comrs., District Bldg., to Union Paving Co., 123 South 21st St., Phila., Pa., sheet asphalt paving (replacement method) $188,627—to McGuire & Rolf, 101 M St. N.E., concrete curbing, guttering, asphalt surfacing $115,720; concrete alleys $105,987; concrete and cement sidewalks, $69,465—to W. F. Brenizer, 101 New York Ave. N.W., $157,766. Grand total $637,565. Noted Feb. 12.

Florida—State Road Dpt., Tallahassee, clearing, grubbing, grading, drainage structures, con-

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crete paving 10.31 mi. Rd. 5, Federal Aid Project 76-A, Hillsborough Co., to Johnson, Drake & Piper, 1138 Baker Bldg., Minneapolis, Minn., $340,149. Noted Feb. 19.

Kentucky—State Hy. Dpt., Frankfort, grading, drainage structures 5.445 mi. Hartford-Fordsville Rd., Ohio Co., to J. B. Westerfield, Owensboro, $55,956; 3.435 mi. Horse Cave-Jackson Hy., Hart Co., to E. A. Chilton Co., London, $18,943—bridge over Cartwright Creek, on Springfield-Bardstown Rd., Washington Co., to Wilmore Constr. Co., Wilmore, $23,087. Grand total $97,986. Noted Nov. 13.

Kentucky—State Hy. Dpt., Frankfort, grading, drainage structures using 1st class pipe, 17.357 mi. Corbin-Cumberland Fall Rd., Whitley Co., to Phelps Constr. Co., Somerset, $166,870; 2.582 mi. Carrollton-Warsaw Rd., Carroll Co., to Southeastern Constr. Co., Eminence, $62,794. Noted Jan. 29.

Kentucky—State Hy. Dpt., Frankfort, to B. W. Gorham Co., Lexington, grading, drainage structures, traffic bound limestone surfacing 3.877 mi. Tyrone Toll Bridge Approaches, Anderson and Woodford Counties, $58,627—to Corum Bros., Madisonville, 2.643 mi. Ohio River Bridge Approaches, Henderson Co., $53,832; grading, drainage structures, bank gravel on river gravel surfacing Cumberland River Toll Bridge Approaches, Livingston Co., $27,176—to Frazer & Cocke, Wickliffe, grading, drainage structures, traffic bound limestone surfacing 3.707 mi. Spottsville Toll Bridge Approaches, Henderson Co., $66,344; 4.175 mi. Tennessee River Toll Bridge Approaches, McCracken and Livingston Counties, $35,410; 1.717 mi. Eggners Ferry Bridge Approaches, Marshall and Trigg Counties, $48,089; 1.801 mi. Cumberland River Bridge Approaches, Trigg Co., $47,696. Grand total $337,174. Noted Dec. 1.

Louisiana—State Hy. Comn., Baton Rouge, 1.6 mi. emergency levee hy., Jefferson Parish, to Baton Rouge Constr. Co., Baton Rouge, $13,976—0.917 mi. Gay Levee Hy., East Baton Rouge Parish, to R. E. Merrill, Baton Rouge, $4,467—7.57 mi. Butler Levee Hy., St. Charles and Jefferson Parishes; to Hoffman & Jones, Madisonville, $15,314 — 1.3 mi. Davis-Louisa Levee Hy., St. Charles Parish, to Tircuit & Co., Plaquemine, $12,138. Grand total $45,895.

Maine—State Hy. Dpt., Augusta, graveling 5.88 mi. hy. Orland, and bituminous macadam and gravel paving 2 mi. hy. Bingham and Moscow, to W. H. Hinman, Skowhegan, $10,475 and $19,131 respectively—gravel surfacing 3.26 mi. hy. Stockton Springs and Orland, to Jos. McCormick & Son, East Providence, R. I., $90,534—1.18 mi. hy. Avon, to J. H. Kerr, Rumford, $15,967—concrete paving 2.84 mi. Warren, to Lane Constr. Corp., 134 State St., Meriden, Conn., $71,278—3.03 mi. hy. Carmel, to A. D. Bridges Sons, Hazardville, Conn., $76,769. Grand total $409,154. Noted Feb. 19.

Maryland—State Roads Comn., Baltimore, G. C. Uhl, chn., concrete paving 1.73 mi. Contr. CI-94-54, Carroll Co., to M. J. Grove Lime Co., Lime Kiln, $49,544. Noted Feb. 12.

Maryland — State Roads Comn., Baltimore, G. C. Uhl, chn., concrete paving 6.4 mi. Contr. CI-89-54-F-156-54, Carroll and Frederick Counties, to G. & L. Contg. Co., Maple Ave., Overlea, Baltimore, $197,358. Noted Feb. 5.

Md., Baltimore—Bd. Awards, curbing 25,000 lin.ft. streets listed in Contr. 582, to Arundel Contg. Co., 910 Trinity St., $16,420; sheet asphalt paving 8,200 ft. streets listed in Contr. 581, to National Paving & Contg. Co., Menlo Dr. and Western Maryland R.R., $33,866. Noted Feb. 19.

Nevada—State Hy. Comn., Carson City, reconstructing hy. in Lander and Eureka Counties, to A. D. Drumm, Jr., Fallon, $172,234. Noted Feb. 19.

New Jersey — State Hy. Comn., Trenton, to Chisholm-Weisgerber, Paramus, grading, 9 in. single line rein.-con. paving 0.21 mi. Passaic Co., $50,623—to S. J. Groves & Son, Ridgefield, 7.43 mi. Burlington Co., $401,255—to E. H. Ellis, Westville, 4.79 mi. Cumberland Co., $141,686; 3.57 mi. Atlantic, Cumberland and Cape May Counties, $105,705; 7.803 mi. Burlington Co., $382,939. Grand total $1,084,208. Noted Feb. 19.

New York and New Jersey—General Manager Port of New York Authority, 80-90 8th Ave., New York, constructing Plaza, section, Port Richmond Approach to Kill van Kull Bridge between Bayonne, N. J. and Port Richmond, N. Y. to Merritt Chapman Scott, 17 Battery Pl., New York, $249,957. Noted Jan. 22.

N. Y., Babylon — Long Island State Park Comn., Administration Headquarters, Belmont Lake State Park, grading, draining 3.5 mi. Northern State Parkway, incl. 5 bridges, to Smith Bros. Constr. Co., Inc., 5th Ave., Pelham, $375,992—paving 2.5 mi. Ocean Parkway, to Johnson, Drake & Piper, 1st Natl. Bank Bldg., Freeport, $222,695—underpass at Jones Beach Park, to Graves-Quinn Corp., Grand Central Terminal New York, $154,269. Grand total $752,956. Noted Jan. 22 and 29.

N. Y., New York—H. Bruckner, pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., sidewalks on various streets, to S. LaBarbera, 65 Webster Ridge, New Rochelle, $858; grading East 153rd St., to F. Del Balso, 1933 West Farms Rd., $11,632 — Navy Ave., to A. Gregorio & Co., Inc., 1121 Neil Ave., $29,658. Grand total $42,148. Noted Feb. 10 Daily.

North Carolina—State Hy. Comn., Raleigh, to R. G. Lassiter & Co., Raleigh Bank & Trust Bldg., Raleigh, grading, drainage structures, sand asphalt paving 7.98 mi. Chowan Co., $101,389; 8.31 mi. Gates Co., $111,010; grading, drainage structures, concrete paving 6.61 mi. Wake Co., $33,885—to F. J. McGuire, Norfolk, Va., 5.55 mi. Craven Co., $125,433; 9.62 mi. Jones Co., $119,413—to Wilson Constr. Co., Asheville, 4.1 mi. Project 8450, $77,026; 2.41 mi. Project 8460, $48,607, both McDowell Co. — to Brown Paving Co., Lexington, 13.22 mi., Moore Co., $248,865—to Forsyth County Hy. Comn., Winston-Salem, 6.64 mi., Forsythe Co., $55,075—to Noll Constr. Co., Builders Bldg., Charlotte, 15 mi. Bladen Co., $262,636—to W. F. Bowe, Jr., Augusta, Ga., 6.24 mi., Stanly Co., $116,365—to Guilford Constr. Co., Greensboro, 4.89 mi., Watauga Co., $101,460—to Roberts Paving Co., Salisbury, Md., 4.45 mi., Columbus Co., $82,247—to West Constr. Co., Chattanooga, Tenn., grading, drainage structures, sand asphalt paving 5.68 mi., Onslow Co., $91,670. Grand total $1,575,081. Noted Feb. 5.

Ohio — O. W. Merrell, hy. dir., Columbus, concrete paving 3.136 mi. hy. Holmes Co., to Stellhorn & Beightler, 2601 Fairfax Rd., Columbus, $128,172—1.893 mi. Williams Co., and 2.196 mi. Defiance Co., to J. A. Elder, 215 West High St., Bryan, $40,597 and $56,644 respectively — 3.5298 mi. Ashtabula Co., to Robinson, Burns & Cooper Co., 337 South High St., Columbus, $206,551—3.886 mi. Columbiana Co., to H. M. Bates, 250 South Court St., Steubenville, $119,057—0.146 mi. Washington Co., to Bellefontaine Development Co., Bellefontaine, $282,007—waterbound macadam paving 0.362 mi. Erie Co., to Dodge-Hussey Constr. Co., 1174 West 5th Ave., Columbus, $23,304—brick on concrete paving 0.129 mi. Lake Co., to R. J. Au, Painesville, $17,500—traffic bound macadam paving 2.419 mi. Meigs Co., to Boso & Ritchie, Jackson, W. Va., $124,338 — straightening, gravel surfacing 1.42 mi. Scioto Co., to Roush Bros., 632 Franklin St., Columbus, $25,637—brick, paving, incl. furnishing, delivering brick 9.737 mi. Guernsey and Muskingum Counties, to Ray Strawser, Inc., 852 North Cassady Rd., Columbus, $342,643 — driving steel piling, concrete fill 810 ft. hy. Hamilton Co. to Swingle & Robinson, 337 South High St., Columbus, $20,244. Grand total $1,286,694. Rejected bids Feb. 24, waterbound macadam paving 4.41 mi. Sect. "Sabina East and Sabina West" Cincinnati-Zanesville Rd., Clinton Co., $127,998. Noted Feb. 12.

Okla., Tulsa—Tulsa Co., concrete surfacing 2 mi. Broken Arrow Rd., 20 ft., to Highway Constr. Co., Daniels Bldg., $55,085 est. $60,000—1 mi. Alsuma Rd., and 1 mi. Bixby Rd., both 22 ft., to R. Tanner, Nebraska Bldg., $27,552 and $25,368 respectively, est. $28,000 each. Grand total $108,105.

Oregon—State Hy. Comn., Salem, grading 6.05 mi. Central Oregon Hy., Sperry, Malheur Co., to W. H. Blunckett, Boise, Idaho, $40,991—33.48 mi. Oregon Trail, Baker and Malheur Counties, to J. C. Compton, McMinnville, $128,215—surfacing patches on Roosevelt Hy., Curry Co., to T. Hull, Brookings, $27,590—resurfacing 30.04 mi. Pacific Hy., Douglas Co., to Northwest Roads Co., Yeon Bldg., Portland, $81,954 — widening, regrading 2.46 mi. Josephine Co., to D. L. Ashton, Lebanon, $34,040—patches, Pilot Rock Co., to Lair & Co., Kelso, Wash., $86,467 — 54.09 mi. Pacific Hy., Lane and Douglas Counties, to E. J. Kernan, Reedsport, $125,165 — broken stone surfacing in patches Roosevelt Hy., Lincoln Co., to Digner & Johnson, Portland, $26,205 — broken stone paving 4.9 mi. Old Oregon Trail, Union Co., to Hart Constr. Co., LaGrande, $63,175 — 2 highway bridges, Douglas Co., to Odom & Frazier, Salem $61,468 — Elk Creek Tunnel on Umpqua Hy., Douglas Co., to Wren & Greenough, Chamber of Commerce Bldg., Portland, $105,785. Grand total $781,055.

Pa., McKees Rocks—J. W. McLaughlin, secy. Bd. Comrs. Stowe Twp., sandstone curbing 4,500 lin.ft. redressing and resetting 1,000 lin.ft. concrete curbing, 1,000 lin.ft .36 in. storm and sanitary sewers, paving 10,000 sq.yd. Bway. Ave., Stowe Twp., near here, to F. D. Thomas Co., Jenkins Arcade, Pittsburgh, $61,327; concrete wall on Davis Ave., to B. M. Brusco & Co., 2135 Pioneer Ave., Pittsburgh. Noted Feb. 5.

Texas—G. Gilchrist, state hy. engr., Austin, to Brown & Root, Inc., Norwood Bldg., Austin, constructing caliche base course 10.678 mi. hy. Kerr Co., 26 ft., $41,929 est. $66,000; triple bituminous on caliche base surface treating 10.957 mi. Runnels Co., $90,414 est. $100,000; double bituminous surface treating 17.13 mi. Edwards Co., $32,961 est. $35,000—to Cocke & Braden, Marshall, 16 mi. Hopkins Co., $30,103 est. $34,000—to McKinney & Parmalee, Nacogdoches, 12 mi. Cherokee Co., $23,833 est. $26,000; 10.203 mi. Wood Co., $19,945 est. $25,000—to Dozier Constr. Co., Littlefield Bldg., Austin, ¾ in. limestone rock asphalt surfacing 9.73 mi. Fayette Co., $18,773 est. $25,000—to Haden & Austin, 328 Post-Dispatch Bldg., Houston, single bituminous surface treating 56.591 mi. Culberson and Hudspeth Counties, $77,095 est. $100,000—to J. W. Gwinn, 1801 Comer Bldg., Birmingham, Ala., limestone rock asphalt on caliche base surfacing 17.289 mi. Kinney Co., $123,969 est. $170,000, all foregoing 18 ft. wide—to Word & Worrell, Itasca, grading, drainage structures 12.434 mi. Guadalupe Co., $65,355 est. $66,000—to J. T. Ables, Madill, Okla., 18.803 mi. McLennan and Bosque Counties, $142,717 est. $200,000 — to E. G. Powell, Box 688, Jacksonville, 16.904 mi. Victoria Co., $55,808 est. $75,000; 11.406 mi. Colorado Co., $52,740 est. $66,000—to E. F. Bucy & Son and C. T. Childs, Rising Star, 12.345 mi. Brown Co., $46,188 est. $64,400—to Sachse & Wise Quitaque 10.55 mi. Hall Co. $24,249 est. $34,000—to Geo. W. Condon & Co., 221 Grain Exch. Bldg., Omaha, Neb., 1.919 mi. Montague Co., $41,902 est. $58,000—to Armstrong & Hudman, Pecos, 17.25 mi. Reeves Co., $54,551 est. $78,000, all foregoing 26 ft. wide —to Moeller & Roberts, Hitchcock, grading, drainage structures, concrete paving 14.257 mi. Harris Co., $477,443 est $500,000—to Dodds & Wedegartner, San Benito, 2 in. rock asphalt on 6 in. concrete paving 9.7 mi. Guadalupe Co., $191,216 est. $220,000; concrete paving 18.668 mi. Henderson and Kaufman Counties, $377,489 est. $420,000—to General Constr. Co., 414 Capps Bldg., Fort Worth, concrete paving 14.242 mi. Brown Co., $271,859 est. $300,000—to R. W. Briggs & Co., Pharr, 16.225 mi. Victoria Co., $333,092 est. $380,000—to Stuckey Constr. Co., Box 1445, Wichita Falls, 7.386 mi. Gray Co., $149,342 est. $190,000—to Earl Yates & Son, Edna, 17.325 mi. Leon Co. $377,581 est. $400,000—to Interstate Constr. Co., Yoakum, 7 in. concrete paving 16.405 mi. hy. Lubbock Co., $345,848 est. $400,000, all foregoing 18 ft. wide. Grand total $3,466,402. Noted Feb. 19 and 26.

Tex., Beaumont—For 1 in. Duraco on 5 in. rein.-con. paving Kenneth, Palm, Blanchette and Royal Sts., and Avenues G, H, F and A, to Uvalde Rock Asphalt Co., First Natl. Bank Bldg., San Antonio, $168,307.

Utah — State Hy. Comn., Salt Lake City, graveling 17.15 mi. Dixie Hy., Washington Co., to O. Nelson, Logan, $26,407 est. $29,920; 1.472 mi. Dixie Hy., Washington Co., to Utah Constr. Co., Ogden, $40,159 est. $45,036. Noted Feb. 19.

Wyoming—State Hy. Dpt., Cheyenne, grading, bridges, Sheridan-Arvada Rd., F. A. P. 206A, to G. Herron, Sheridan, $25,964—Worland Tensleep Rd., F. A. P. 108C, to Blanchard Bros., 1641 South Logan St., Denver, Colo., $51,092—on Lusk-Lingle Rd., to Wyoming Constr. Co., Laramie, $21,756—10.167 mi. F. A. P. 193, to Haas, Doughty & Jones, Merchants Exch. Bldg., San Francisco, Calif., $54,112—1.397 mi. Telephone Canyon Rd., F. A. P. 153B, and surfacing 1.429 mi. Telephone Canyon Rd., F. A. P. 887 and 153B, to Reel Constr., Inc., Sidney, Neb., $25,696 and $40,169 respectively — bridges on 10.167 mi. Kemerer-Fossil Rd., to True & Knutsen, Cheyenne, $11,930. Grand total $230,449.

EXCAVATION

PROPOSED WORK

Calif., Oakland — City Port Comn., G. B. Hegardt, secy., surveys harbor development, incl. piers, berthing space for 90 large vessels, transit sheds, warehouses, on North Harbor.

Ga., Augusta—Augusta Levee Comn., T. S. Gray, chn., adopt resolution to ask city and county to widen levee 20 ft. from city stockade to Sand Bar ferry bridge. $20,000.

Ind., Goshen—Bd. Comrs. Elkhart Co. constructing Molebach-Fisher-Gordon Ditch, $25,000. F. Mishler, Goshen, asst.

Ind., Huntington—Bd. Comrs. Huntington Co., 4,000 ft. W. C. McPherson Ditch. $25,000. E. E. Collins, Huntington, engr.

Ind., Rushville—Bd. Comrs. Rush Co., constructing, dredging 12 mi. Manzy Ditch, Posey and Walker Twps., $40,000; dredging Blue River Drain, $32,000. A. Cameron, Rushville, engr.

Ia., Sioux City — Woodbury Co., bids this spring improving Reynolds Creek, incl. 200,000 cu.yd. excav. E. L. Ferguson, 512 U. B. Bldg., engr. Noted Nov. 13.

Mass., Rockport—Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, dredging in Rockport Harbor, $25,000. A. W. Dean, Dpt. P. Wks., Boston engr.

Mass., Weymouth—Town, W. A. Connell, chn. Selectmen, plans sea wall, north side of Fore River Ave., $25,000.

Mass., Winthrop — Town, Bd. Selectmen, dredging Winthrop Yacht Club Channel and drainage in nearby streets. $26,000.

BIDS ASKED

Ind., Logansport — Mar. 14, by Bd. Comrs. Cass Co., Ulerick Open Ditch and 3 tile tributaries, $25,000; Beecher Ditch and tributaries, $25,000. W. Y. Walker, Logansport, engr.

CONTRACTS AWARDED

N. J., Newark—State Hy. Comn., Trenton, rein.-con. retaining walls on precast concrete piles and embankment on Route 29, Sect. 10A, to J. F. Chapman & Son, Hillside, $105,821. Noted Feb. 19.

N. Y., Babylon — Long Island State Park Comn., Administration Bldg., Belmont Lake Park, 2,500,000 cu.ft. hydraulic fill, Ocean Parkway, to Standard Dredging Co., 233 Bway., New York, $260,250. Noted Jan. 29.

O., Cleveland—Dredging Cuyahoga River, to Great Lakes Dredge & Dock Co., Williamson Bldg., $89,500.

Bond Elections

Coming Bond Elections

Sewage Disposal Plant, etc.—Mexico, Mo., Mar. 12, $65,000.

Power Plant—Oakdale, La., Mar. 24, $90,000.

Schools—Los Angeles, Calif., $9,000,000 to $12,000,000.

Bonds Voted

Storage Tank, Booster Pumping Plants, etc.—Exeter, Calif., $24,000. I. H. Althouse, Portersville, Engr.

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Bond Elections (Continued)

Main Extensions,—Ponca City, Okla. C. F. Hicks, Ponca City, Engr., $36,000.

Waterworks—Falls Church, Va., $125,000.

Gas Distribution System — Garber, Okla., $27,000. Long & Co., Oklahoma City, Engr.

Park Impvts—Beaumont, Tex., Mar. 28, $100,000.

Court House—Russellville, Ark., Pope County, $150,000.

Court House — Wellington County, Tex. $175,000.

Bonds Defeated

Light Plant—Fairfax, Okla., $120,000.

FEDERAL GOVERNMENT

PROPOSED WORK

Conn., New London—BUILDING—Spec. 6429—Yards & Docks, Navy Dpt., replacing Building 40, at Navy Yard.

Del., Wilmington — ELECTRICAL EQUIPMENT — U. S. Eng. soon takes bids alternating current electrical equipment for 4 bridges on Chesapeake & Delaware Canal.

Fla., Tampa—DREDGING—U. S. Eng., Jacksonville, rejected bids Jan. 22, dredging in Sparkman Channel. Noted Jan. 15.

Ill., Chicago—FOUNDATION—Treas. Dpt. at office Sup. Archt., soon takes bids foundation for U. S. Post Office, Harrison and Van Buren Sts. Graham, Anderson Probst & White, 80 East Jackson Blvd., archts.

La., Opelousas—POST OFFICE—Treas. Dpt. at office Sup. Archt., 3 story, 37 x 74 ft., brick, rein-con., addition. $85,000.

Mass., Bourne—STATION—U. S. Coast Guard Serv., coast guard station, Monument Point.

Mass., Watertown—WATERWORKS—U. S. Eng., high pressure water system at U. S. Arsenal. $65,000 appropriated.

N. J., Fort Monmouth — OFFICERS QUARTERS, etc.—Con. Q. M., brick, steel officers quarters, non-commissioned officers quarters, post hospital addition. $490,000. **Maturity probably soon.**

N. Y., Oswego—LIGHTHOUSE—U. S. Eng., Buffalo, new lighthouse in Oswego Harbor. $140,000.

Pa., Phila.—FEDERAL COURT—Treas. Dpt. at office Sup. Archt., federal court building, 9th and Market Sts. $2,900,000.

R. I., Melville—CHIMNEY—Spec. 6290—Yards & Docks, Navy Dpt., 100 ft. radial brick chimney.

R. I., Newport — ASSEMBLY SHOP — Spec. 6437—Yards & Docks, Navy Dpt., extending assembly shop at Naval Torpedo Station, Goat Island.

R. I., Newport—POWER PLANT—Yards & Docks, Navy Dpt., extending, improving power plant at U. S. Naval Training Station. $50,000.

R. I., West Warwick—POST OFFICE—Treas. Dpt. at office Sup. Archt., rejected bids Feb. 11, U. S. Post Office. Will readvertise. Noted

R. I., Woonsocket — POST OFFICE — Treas. Dpt. at office Sup. Archt., revised plans altering and constructing addition. $165,000. Former bids rejected. Noted Jan. 8.

Tex., Galveston—IMMIGRATION STATION—Treas. Dpt. at office Sup. Archt., immigration station, Avenues A and B, 17th and 18th Sts. $375,000.

T. H., Pearl Harbor—DREDGING—Spec. 6299—Yards & Docks, Navy Dpt., 2,900,000 cu.yd. at Naval Operating Base.

France, Paris—EMBASSY—State Dpt., c/o Committee on Foreign Buildings, completed plans, specifications and soon takes bids embassy building. $1,600,000. Delano & Aldrich, 126 East 38th St., New York, archts. Noted Feb. 5.

BIDS ASKED

Arizona—ROAD—Mar. 24, by C. H. Sweetser, dist. engr., Pub. Rds., 508 Ellis Bldg., Phoenix, grading 4.341 mi. Sect. 2D, Swift Trail, Major Forest Development, Graham Co.

Calif., San Francisco—QUARTERS—Mar. 25, by Con. Q. M. Fort Mason, 15 double sets non-commissioned officers quarters, at San Francisco Presidio.

D. C., Wash.—SPRINKLING SYSTEM—Mar. 31, at office H. D. Rouzer, acting archt. Capitol, furnishing, installing underground lawn sprinkling system, within area enlargement of U. S. Capitol Grounds; adv. E. N.-R. Mar. 12.

D. C., Wash.—WALKS—Mar. 25, at office H. D. Rouzer, acting archt. of Capitol, constructing walks on site for enlargement U. S. Capitol grounds; adv. E. N.-R. Mar. 12.

Fla., Key West—METAL WORK—Mar. 31, by Superintendent Lighthouses, furnishing, delivering f.o.b. shipping point metal work for 9 iron towers; adv. E. N.-R. Mar. 12.

Fla., Pensacola—GRADING, etc.—Spec. 6424—Mar. 18, by Yards & Docks, Navy Dpt., at office Sup. Archt., grading, asphalt paving.

Ga., Fort Benning—OFFICERS—Mar. 31, at office Con. Q. M., 5 field officers' and 51 company officers' quarters; adv. E. N.-R. Mar. 12.

Ill., Waukegan—BREAKWATER, etc.—Mar. 26, by U. S. Eng., 333 North Michigan Ave., Chicago, 270 ft. concrete caisson breakwater, 1,030 ft. steel sheet pile shore connection; adv. E. N.-R. Mar. 12.

Ind., Fort Benjamin Harrison—QUARTERS—Mar. 24, at office Con. Q. M., 4 single sets and 2 double sets non-commissioned officers quarters; adv. E. N.-R. Mar. 12.

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La., Harvey — TRESTLE, etc. — Apr. 7, at office U. S. Eng., New Orleans, clearing site, sheet pile cofferdam, excavating, driving foundation piling, sheet pile cut-off walls, concrete lock walls and floor, incl. reinforcing steel, temporary open deck timber trestle under tracks Texas Pacific-Missouri Pacific Terminal R.R. of New Orleans, providing maintenance on trestle, until such time as traffic is suspended thereon and routed over new bridge, in connection with lock to be constructed in Mississippi River, here; adv. E. N.-R. Mar. 12. Noted Dec. 11.

La., New Orleans—EXCAVATOR—Apr. 4, by U. S. Eng., 2nd New Orleans Dist., foot Prytania St., 1 truck type dragline excavator; adv. E. N.-R. Mar. 12. Noted Feb. 12.

La., Shreveport—QUARTERS—Mar. 27, at office Con. Q. M. Barksdale Field, 30 double non-commissioned officers quarters, at Barksdale Field; adv. E. N.-R. Mar. 12.

La., Shreveport—QUARTERS—Apr. 10, by Con. Q. M., 40 buildings for commissioned officers quarters, at Barksdale Field.

La., Shreveport — BARRACKS — Apr. 9, by Con. Q. M., 3 enlisted men's barracks, at Barksdale Field; adv. E. N.-R. Mar. 12.

Mich., Fort Wayne—QUARTERS—Mar. 30, by Con. Q. M., 3 double sets non-commissioned officers quarters.

Mich., Selfridge Field—STABLES—Mar. 30, by Con. Q. M., 2 stables.

Mo., St. Louis—PONTOONS—Mar. 25, at U. S. Eng., 428 Customhouse, 14 steel dredge pontoons; adv. E. N.-R. Mar. 12.

Nev., Rawthorne—DAM—Spec. 6165—Mar. 25, by Yards & Docks, Navy Dpt., constant angle type concrete dam, at Naval Ammunition Dept.

New Jersey—DREDGING—Mar. 27, by U. S. Eng., 39 Whitehall St., New York, 644,000 cu.yd. material in Newark Bay and Hackensack River; adv. E. N.-R. Mar. 12.

N. J., Trenton—FOUNDATIONS—Mar. 19, by Treas. Dpt. at office Sup. Archt., foundations for U. S. Post Office.

N. M., Clovis—POST OFFICE—Apr. 3, by Treas. Dpt. at office Sup. Archt., U. S. Post Office.

N. M., Lordsburg—AIRWAYS OFFICE, etc.—Mar. 18, by Con. Q. M., Fort Bliss, Tex., airways operations office building and installing gasoline and oil storage tanks, at U. S. Army Airdrome 4 mi. southeast of here.

N. Y., Brooklyn—MOTOR GENERATOR, etc.—Mar. 31, by Signal Supply Officer, Signal Sect., New York General Depot, Army Base, motor generator, cable.

N. Y., Canandaigua—HOSPITAL—Apr. 14, by Vet. Bu., Arlington Bldg., U. S. Veterans Hospital, incl. roads, walks, grading, drainage; adv. E. N.-R. Mar. 12. Noted Sept. 4.

Tenn., Memphis—DREDGING—Apr. 3, by U. S. Eng., Memphis, 5,223,000 cu.yd. earthwork in Upper St. Francis, Upper Yazoo, and White River Levee Dists.; adv. E. N.-R. Mar. 12.

Tex., Brownsville — POST OFFICE — Treas. Dpt. at office Sup. Archt., bids about Mar. 15, 2 story, basement, brick, tile, rein.-con. post office. $430,000. Noted Feb. 26.

Tex., Fort Sam Houston—QUARTERS—Apr. 3, at office Con. Q. M., 3 field officers quarters and 14 company officers quarters; adv. E. N.-R. Mar. 12.

Tex., Fort Worth—POST OFFICE—May 1, by Treas. Dpt. at office Sup. Archt., 3 story, 200 x 270 ft. post office. $1,240,000. Noted Feb. 5.

Tex., Lubbock—POST OFFICE—Apr. 10, by Treas. Dpt. at office Sup. Archt., U. S. Post Office; adv. E. N.-R. Mar. 12. Noted Feb. 5.

Va., Langley Field—BARRACKS—Apr. 7, at office Con. Q. M., Fort Monroe, 2 air corps barracks; adv. E. N.-R. Mar. 12.

Wash., Fort Lewis—QUARTERS—Apr. 2, at office Con. Q. M., 6 field officers and 27 company officers quarters; adv. E. N.-R. Mar. 12.

Wash., Seattle — GRADING, etc. — Yards & Docks, Navy Dpt., bids about Mar. 16, grading landing field at Sand Point Naval Air Station, Lt. Comm. Morril. Puget Sound Navy Yard, Bremerton, engr.

Alaska—BRIDGE, etc.—Mar. 27, by Pub. Rds., Juneau, constructing Resurrection River Bridge, steel, timber, over Resurrection River; clearing, grubbing, grading, crushed rock on gravel surfacing 1.325 mi. South Glacier Hy. M. D. Williams, Juneau, engr.

Alaska — ROAD — Mar. 25, by Pub. Rds., Juneau, grading, graveling 1.019 mi. Wrangle Hy. M. D. Williams, dist. engr.

Canal Zone — DAM — General Purchasing Officer Panama Canal, will issue invitation bids about July 1, constructing Madden Dam, auxiliary works on Chagres River; adv. E. N.-R. Mar. 12.

T. H., Fort Shafter—BARRACKS, etc.—Mar. 26, by Con. Q. M., two 200 men air corps barracks, roads and utilities, at Wheeler Field.

CONTRACTS AWARDED

Calif., San Diego—QUAY WALL—Spec. 6400—Yards & Docks, Navy Dpt., quay wall, to W. E. Kier, 1st Natl. Bank Bldg., San Diego, $72,919.

D. C., Wash. — FOUNDATIONS — At office D. Lynn, archt., Capitol, excavation and found. for United States Supreme Court Buildings on Squares 727 and 728, to G. B. Mullin Co., Inc., 1296 Upshur St., $82,000. Noted Feb. 5.

D. C., Wash.—ROAD—Dpt. Agriculture, Pub. Rds., constructing 7¼ mi. Sect. 1, Unit 4 Mount Vernon Memorial Hy., to MacDougal Constr. Co., Angier Springs Rd., Atlanta, Ga., $605,619; 7¼ mi. Sect. 2 same road, to Roberts Paving Co., Salisbury, Md., $557,440. Noted Jan. 22.

Fla., Kissimmee—POST OFFICE—Treas. Dpt. at office Sup. Archts., U. S. Post Office, to Samford Bros., Montgomery, Ala., $51,491. Noted Jan. 22.

Fla., Pensacola—FILLING, DRAINAGE, etc.—Spec. 6406 and 6394—Yards & Docks, Navy Dpt., filling, grading, Item 2, to Shell Producers Co., Tampa $87,000; Item 3, to L. M. Harvey, Pensacola $129,000; filling, grading bulk-head for runway, to C. H. Turner, Pensacola, $55,240. Grand total $271,240. Noted Feb. 19.

Illinois—LEVEE—U. S. Eng., Rock Island, enlarging existing levee and constructing new levee in Bay Island Drainage and Levee Dist. 1, Sect. 1, to Union Constr. Co., 200 New York St., Des Moines, Ia.; Sect. 2, to Winston Bros. Co., 1564 Northwest Bank Bldg., Minneapolis, Minn. Noted Jan. 15.

Ind., Warsaw—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to Ideal Constr. Co., Gary, $64,000. Noted Feb. 27 Daily.

Ia., Oelwein—POST OFFICE—Treas. Dpt., at office Sup. Archt., U. S. Post Office, to W. D. Lovell Co., 1415 Southeast 8th St., Minneapolis, Minn., $56,800. Noted Jan. 22.

Ky., Madisonville — POST OFFICE — Treas. Dpt. at office Sup. Archt., U. S. Post Office, to J. I. Barnes, Logansport, Ind., $58,700. Noted Jan. 29.

Me., Brunswick—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post office to W. MacDonald Constr. Co., Syndicate Trust Bldg., St. Louis, Mo., $64,880. Noted Jan. 29.

Mass., Hingham — DREDGING — Yards & Docks, Navy Dpt., Boston, dredging, bulkhead, pier rebuilding, to Merritt Chapman & Scott, 292 Pequot Ave., New London, Conn., $37,512 plus $0.75 per cu.yd. dredging. Noted Feb. 19.

Mass., Taunton—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office addition, to J. R. and J. A. Whelan, Inc., 135 Pelham St., Newport, R. I., $155,085. Noted Jan. 29.

Michigan—DREDGING—U. S. Eng., Detroit, Mich., dredging, rock excav., Vidal Shoals, St. Mary's River, to Duluth Superior Dredging Co., foot 45th Ave. W., Duluth, Minn., $595,492. Noted Jan. 15.

Mo., Sikeston—POST OFFICE—Treas. Dpt. at office Sup. Archt., U. S. Post Office, to Hiram Lloyd Building & Constr. Co., Syndicate Trust Bldg., St. Louis, $57,800. Noted Jan. 29.

N. Y., Buffalo—BREAKWATER—U. S. Eng., 1,800 lin.ft. southbreakwater at Buffalo Harbor, to F. G. Hanssel, Ellicott Sq., $176,410. Noted Jan. 29.

N. Y., Fort Plain—POST OFFICE—Treas. Dpt. at office Sup. Archt., post office, to Rosen & Fischel, 11 South LaSalle St., Chicago, Ill., $68,700. Noted Jan. 29.

N. Y., New York — FOUNDATION — Treas. Dpt. at office Sup. Archt., foundations for U. S. Parcel Post Building, to I. B. Miller, 406 West 38th St., $631,413. Noted Feb. 5.

N. Y., Oswego—BREAKWATER—U. S. Eng., Buffalo, removing 2,485 ft. old breakwater at Oswego Harbor, to Great Lakes Dredging & Dock Co., Morgan Bldg., Buffalo, $736,460. Noted Jan. 29.

North Carolina and Florida—DREDGING—U. S. Eng., Wilmington, N. C., 10,383,313 cu.yd. in Cape Fear River to Little River portion Intracoastal Waterway from Cape Fear River, N. C. to St. Johns River, Fla., Sect. 1, to R. C. Huffman, Constr. Co., Terminal Tower Bldg., Cleveland, O., $670,773; Sect. 2, to be done by government plant $405,267. Noted Feb. 5.

N. C., Salisbury—POST OFFICE—Treas. Dpt., at office Sup. Archt., remodeling, extending U. S. Post Office, to Grahm Constr. Co., Red Rock Bldg., Atlanta, Ga., $143,284. Noted Dec. 18.

Okla., Bartlesville—POST OFFICE—Treas. Dpt., at office Sup. Archt., U. S. Post Office, to W. R. Heath Constr. Co., Greencastle, Ind., $195,630. Noted Jan. 29.

Pa., Pittsburgh—LOCK—U. S. Eng., concrete, steel dam near Bamfert Station, to Dravo Contg. Co., Neville Island (mail McKees Rocks), $1,196,916. Noted Jan. 8.

S. C., Parris Island—PAVING—Spec. 6410—Yards & Docks, Navy Dpt., concrete and bituminous paving at U. S. Marine Barracks, to Espy Paving & Concrete Co., 2809 Bull St., Savannah, Ga., $77,153. Noted Feb. 12.

Va., Hampton Roads—TANKS—Spec. 6398—Yards & Docks, Navy Dpt., tanks, to McCay & Kirkland, Equitable Bldg., Baltimore, Md., $25,490.

Vt., East Richford—INSPECTION STATION—Treas. Dpt. at office Sup. Archt., U. S. Inspection Station, to D. H. Walker, 17 Thorndike St., Lowell, Mass., $52,000. Noted Feb. 5.

T. H., Pearl Harbor—HANGAR—Spec. 6215—Yards & Docks, Navy Dpt., seaplane hangar, to Ames-Will Ltd., Pier 9, Honolulu, $203,430 (300 days). Noted Jan. 8.

SUBWAYS AND TUNNELS

BIDS ASKED

Pa., Phila.—Apr. 7, by Dpt. City Transit, C. E. Myers, dir., City Hall Annex Contr. 205, portion Broad Street Subway from south of South St. to south of Snyder Ave., incl. 7,285 lin.ft. 2 track subway, 3 passenger stations of island platform type, underpass for future track at Passyunk Ave. $5,000,000.

CONTRACTS AWARDED

Pa., Phila.—Dpt. City Transit, City Hall Annex, C. E. Myers, dir., repairs, changes to subway station equipment at 1410 Ludlow St., Park Ave., Cumberland St. and 1333 Mt. Vernon St., Contr. 232, to Allis-Chalmers Mfg. Co., West Allis, Wis. Noted Feb. 12.

GRADE CROSSINGS

PROPOSED WORK

Calif., Santa Ana—City Council postponed taking bids to have been opened Feb. 9, rein.-con. grade separation structure. $150,000. Noted Jan. 29.

Massachusetts — Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, New York, New Haven & Hartford R.R., E. E. Oviatt, ch. engr., New Haven, Conn., and respective towns, grade crossing—overpass—Town Way, ¼ mi. west of village, in Millis, $60,000—grade crossing—overpass—state hy., at East Brewster Station, Brewster, $50,000.

Massachusetts — Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, Boston & Maine R.R., W. J. Backes, ch. engr., Boston, and respective towns grade crossing—overpass—Town Way Main St., Reading, $500,000; Bryants Crossing, Deerfield, $125,000; Hales Crossing, Bernardston, $150,000. A. W. Dean, Dpt. P. Wks., Boston, engr.

Mass., Ashburnham — Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, Town, and Boston & Maine R.R. Co., W. J. Backes, ch. engr., Boston, grade crossing-overpass-Town Way, Pequoig Crossing, $50,000. A. W. Dean, Dpt. P. Wks., Boston, engr.

Mass., Northbridge—Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, Town, and New York, New Haven & Hartford R.R. Co., E. E. Oviatt, ch. engr., New Haven, Conn., grade crossing-overpass-Town Way, Linwood Crossing, $100,000. A. W. Dean, Dpt. P. Wks., Boston, engr.

Mass., Quincy—City, Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, and New York, New Haven & Hartford R.R. Co., E. E. Oviatt, ch. engr., New Haven, Conn., grade crossing—overpass—city way, Willard St. $250,000. A. W. Dean, Dpt. P. Wks., State House, Boston, engr.

Mass., Winchester — Commonwealth of Massachusetts, Dpt. P. Wks., State House, Boston, Town and Boston & Maine R.R. Co., W. J. Backes, ch. engr., Boston, plans grade crossing, underpass or overpass, Town Way, Main and Church Sts. $3,000,000. A. W. Dean, Dpt. P. Wks., Boston, engr.

N. J., Elberon—New York & Long Branch R.R. Co., G. F. Baker, pres., 143 Liberty St., New York, soon takes bids eliminating North Lincoln Ave. Grade Crossing. $146,358.

N. J., Lakewood—Bd. Freeholders Ocean Co., Court House, Toms River, concrete, steel double underpass at Lakewood R.R. Crossing to obviate 2 crossings for through traffic in 2 directions on Lakewood-Adelphia and Lakewood-Toms River Rds., also travel from West Jersey over proposed new road from Lakehurst. $25,000. H. C. Shinn, Municipal Bldg., co. engr. Noted Feb. 12.

N. J., Trenton—Pennsylvania R.R. Co., T. J. Skillman, ch. engr., Broad Street Sta., Phila., Pa., eliminating grade crossing Hermita Ave. and building tunnel. $150,000.

O., Toronto—City, overhead bridge to cross Pennsylvania R.R., Trenton St. $180,000. C Cox, Toronto, engr.

Utah, Salt Lake City—Los Angeles & Salt Lake R.R. Co., R. L. Adamson, ch. engr., Pacific Electric Co., Los Angeles, Calif., overhead crossing. $38,964. State, Toole Co., and Federal Govt. to share cost.

BIDS ASKED

N. Y., Waterloo—Mar. 7, by New York Central R.R. Co., F. B. Freeman, ch. engr., 466 Lexington Ave., New York, overpass and 2 approaches at Junius Junction, near here. $150,000.

CONTRACTS AWARDED

Nevada—State Hy. Comn., Carson City, concrete, steel grade, separation structure in Pershing Co., to A. D. Drumm, Jr., Fallon, $33,052. Noted Feb. 19, under "Bridges."

Tex., Fort Worth—City, c/o O. E. Carr, mgr., and Missouri, Kansas & Texas R.R. Co., c/o Z. G. Hopkins, St. Louis, Mo., and Fort Worth, rein.-con., steel underpass, two 20 ft. roadways, two 6 ft. sidewalks, to Parrott Constr. Co., 1st Natl. Bank Bldg., Dallas. $39,494. Railroad to furnish cement and I-beams.

PIERS AND WHARVES

CONTRACTS AWARDED

Tex., Orange—WHARF—Southern Pacific Ry. Co., Orange, 80 ft. concrete, timber loading and unloading wharf, 30 ft. wide, to A. F. Wilson, Orange, $35,000.

AIRPORTS

PROPOSED WORK

Calif., North Long Beach (br. Long Beach)—Mexican Central Airways, Inc., c/o H. R. Davies, archt., 430 East Ocean Ave., Long Beach, preliminary plans terminal. $150,000.

Ill., Rock Island—City airport, incl. hangars, waiting station, concrete runways, beacon, grading, drainage, 38th St. $800,000. L. Macomber, 664 Michigan Ave., Chicago, engrs.

GRAIN ELEVATORS

PROPOSED WORK

Alta., Woolford—GRAIN ELEVATOR—Midland Pacific Grain Co., grain elevator. $100,000.

POWER AND LIGHTING

PROPOSED WORK

Okla., Mulhall—Mulhall Gas Co. granted franchise natural gas system. $25,000. Private plans.

Okla., Okemah — City preliminary plans natural gas distribution system. $50,000. C B. Stout, mayor.

Okla., Porum—H. E. Dowd granted franchise natural gas system. $25,000.

Pa., Pittsburgh—See "Bridges."

BIDS ASKED

Okla., Garber — Mar. 18, by C. N. Birdsall, city clk., natural gas distribution system, incl. 6,500 lin.ft. 4 in., 9,200 lin.ft. 3 in., and 23,000 ft. 2 in. steel pipe. $27,000. Long & Co., 1300 Colcord Bldg., Oklahoma City, engrs.

CONTRACTS AWARDED

Ariz., Casa Grande—Electrical Dist. 9, 90 mi. power mains, laterals, to Miracle Constr. Co., 404 Security Bldg., Phoenix. $250,000 bonds sold for above work. Noted Feb. 5.

PARKS AND SPORTS

PROPOSED WORK

Ga., Gainesville—Riverside Military Academy, c/o S. Beaver, pres., concrete football stadium for 1931 season.

La., Gretna—Gretna Swimming Pool Assn., soon lets contract concrete swimming pool, dressing rooms. $25,000. T. L. Perrier, Maritime Bldg., New Orleans, engr.

Mass., Boston—Park Dpt., 33 Beacon St., locker at Charlestown Heights, Charlestown. $25,000. Engineer not selected.

Mass., Boston—City, Park Dpt., 33 Beacon St., public playground, Kimball and Greenwich Sts., Dorchester. $49,000. J. J. Murphy, 33 Beacon St., engr.

Mass., Boston — City, Park Dpt., 33 Beacon St., plans concrete bleachers, at Ronan Park, Dorchester. $40,000. J. J. Murphy, Park Dpt., 33 Beacon St., engr.

Mass., Boston — City, Park Dpt., 33 Beacon St., improving William Amerena Playground, East Boston. $25,000 appropriated.

Mass., Danvers—Town, O. E. Jackson, chn. comn., in charge, plan park development and general improvements. $25,000. Little & Brown, 114 Federal St., Boston, archts.

Mass., Easton—Town, L. H. Porter, chn. Bd. Selectmen, public playground, Church St. $25,000.

Mass., Mattapoisett—Mattapoisett Golf Club, Inc., H. H. Brown, Fairhaven, improving golf course, clubhouse. To exceed $25,000. Private plans.

BIDS ASKED

Me., Kents Hill—Mar. 16, by Maine Wesleyan Seminary & Women's College, T. W. Watkins, and Bunker & Savage, archts., 256 Water St., Augusta, 1 story, 70 x 120 ft. and 25 x 100 ft. brick, concrete gymnasium and locker. $70,000. Noted Feb. 19.

CONTRACTS AWARDED

N. Y., Babylon — Long Island State Park Comn., Administration Headquarters, Belmont Lake State Park, installing pipe at Heckscher and Sunken Meadow State Parks, to W. G. Fritz Co., Bridgehampton. $26,000. Noted Feb. 12.

N. Y., Brooklyn—Brooklyn National League Ball Club, Bedford Ave and Sullivan St., stands in ball park, at Bedford and Sullivan Aves., to John Kennedy Constr. Co., 1133 Bway., New York. Est. $100,000.

HEATING AND VENTILATING

BIDS ASKED

R. I., Portsmouth—Mar 13, by Portsmouth Priory School, S. W. Knowles, pastor, furnishing, installing plumbing, heating and electric equipment in school and dormitory, Corey's Lane. Est. $25,000. Maginnis & Walsh, Statler Bldg., Boston, Mass., engrs. Noted Dec. 25, under "Schools."

CONTRACTS AWARDED

Mass., Belmont (br. Boston)—Town, Building Comn., heating and ventilating in grade school, School St., to R. B. Crocker Co., 107 Massachusetts Ave., Boston. Noted Feb. 12, under "Schools."

UNCLASSIFIED

PROPOSED WORK

Mass., Braintree — COMFORT STATION — Town, E. Avery, chn. Selectmen, plans brick, concrete comfort station, South Braintree Sq. $30,000. Engineer not selected.

Mass., Newburyport — TOWER — Atkinson Common Comn., A. Hoyt, chn., 20 Oakland St., sketches brick, steel concrete memorial tower, 65 ft. high, and dome, Atkinson Common. $25,000. Private plans.

Mich., Marysville—RAIL and WATER TERMINAL—See "Factories and Mills."

Pa., Monessen — DOCK, DREDGING, etc. — American Sheet & Tin Plate Co., Frick Bldg., Pittsburgh, dock equipped with crane and crane runway, also dredging, on Monongahela River. To exceed $100,000.

Texas—GAS PIPE LINE—Pecos Valley Gas Co., Fort Stockton, 22 mi. 10 in. natural gas pipe line from Fort Stockton to Alpine and Marfa. $100,000. Private plans.

Texas—PIPE LINE—Magnolia Petroleum Co., Magnolia Bldg., Dallas, 10 in. pipe line from Center to Latex, to connect with Smackover and Eldorado line. $850,000.

BIDS ASKED

Ky., Paducah—WATER TERMINAL and BULK REDISTRIBUTION TANKS—See "Contracts Awarded."

N. Y., Creedmoor—REFRIGERATION—Apr. 1, by Commissioner Dpt. Mental Hygiene, State Office Bldg., Albany, refrigerating work, laboratory building at Creedmoor State Hospital; adv. E. N.-R. Mar. 12.

N. Y., New York—ELEVATORS—May 20, by Bd. Trustees New York State Roosevelt Memorial Museum of Natural History, 15 West 77th St., elevators at Roosevelt Memorial. To exceed $40,000. Noted Dec. 25, under "Public."

N. Y., New York—STATION FINISH—Mar. 17, by Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., station finish work for Broadway-Nassau Street and High Street-Brooklyn Bridge Stations Rapid Transit Railway, Manhattan and Brooklyn Boros.

CONTRACTS AWARDED

Ky., Paducah—WATER TERMINAL and BULK REDISTRIBUTION TANKS—Standard Oil Co. of Indiana, water terminal and bulk redistribution tanks, separate contracts. Est. exceeds $40,000.

Texas and Arizona—PIPE—Western Gas Co., subsidiary El Paso Natural Gas Co., El Paso, Tex., furnishing 65 mi. O.D. pipe for gas pipe line west of Douglas, Ariz., to Republic Iron & Steel Co., 335 Market St., Youngstown, O.; furnishing 235 mi. 12¾ in. O.D. pipe for gas line between El Paso, Tex., and Douglas, Ariz., to A. O. Smith Corp., 27th and Keefe Sts., Milwaukee, Wis., $2,400,000. Noted Feb. 5, under "Contracts Awarded."

Tex., Tyler—TANKS and METAL WORK—Taylor Refining Co., Tyler, tanks and metal work to Wyatt Boiler & Metal Wks., West Dallas, and 15 Park Row, New York. Est. $60,000.

MATERIALS

BIDS ASKED

ROCK RIPRAP—**Los Angeles, Calif.**—Bd. Comrs. Los Angeles Co. taking bids 10,000 tons rock riprap for Flood Control Dpt. E. C. Eaton, ch. flood control engr.

ROAD SURFACING TAR—**Hartford, Conn.**—Mar. 17, by Bd. Contr. & Supply, 90,000 gal. more or less road surfacing tar to be used in surface treating macadam streets. Bidders will quote on 82,000 gal. furnished and applied as directed on any street and on 8,000 gal. delivered to city distributing wagons at bidders storage if within city limits, otherwise in tank car f.o.b. Hartford; adv. E. N.-R. Mar. 12.

PORTLAND CEMENT, etc.—**Hartford, Conn.**—Mar. 18, by Bd. Contr. & Supply, R. Dillon, 3,000 bags portland cement, 400 ft. 8 in., 3,500 ft. 10 in., 400 ft. 12 in. vitr. tile pipe, and 250 ft. 10 in. bends. R. N. Clark, city engr.

LUMBER, etc.—**Chicago, Ill.**—Mar. 13, by City, City Hall, 49,590 ft. b.m. treated superstructural fir timbers and joints at municipal plant, 31st St. and Sacramento Ave. R. W. Wolfe, comr. P. Wks.

BRIDGE LUMBER, etc.—**Algona, Ia.**—Mar. 17, at office Auditor Kossuth Co., 4 carloads fir bridge lumber, 1 carload red cedar piling, 2 carloads creosoted lumber and piling, 5,000 lin.ft. 15 in. culverts, 60 kegs spikes.

STRUCTURAL STEEL—**Orange City, Ia.**—See "Bridges."

GASOLINE, GREASE, etc.—**Toledo, Ia.**—See "Streets and Roads."

CONCRETE PIPE—**Baton Rouge, La.**—Mar. 31, by Road & Bridge Com. of Police Jury, 5,635 lin.ft. 12- to 36-in. concrete bell and spigot pipe (to conform with requirements of American Society of Testing Materials), delivered in car load lots to Baton Rouge, Zachary, Sharp, and Kleinpeter Stations. C. M. Bomar, acting secy.

SAND, CRUSHED STONE, GRAVEL, etc.—**Baltimore, Md.**—Mar. 18, by Bd. Awards, furnishing, delivering sand, crushed stone, gravel, cinders and blast-furnace slag. N. L. Smith, Municipal Bldg., hys. engr.

WATER METERS—**Baltimore, Md.**—Mar. 18, by Bd. Awards, furnishing, delivering disc water meters to Bureau Water Supply. E. G. Rost, Municipal Bldg., water engr.

STEEL PIPE—**Boston, Mass.**—Mar. 26, by Transit Dpt., 1 Beacon St., 4,500 ft. 4 in. steel pipe, fittings.

BITUMINOUS MATERIAL—**St. Paul, Minn.**—Mar. 17, State Hy. Dpt., 10,000,000 gal. bituminous materials and apply same on roads—various trunk hys.

TAR, etc.—**Newton, N. J.**—Mar. 20, by Bd. Freeholders Sussex Co., Court House, 250,000 gal. tar, 31,000 gal. cold patch, 350 tons calcium chloride dust layer, 9,000 tons dustless screenings, 1,000 tons 2½ in., 1,800 tons 1½ in. and 1,200 tons ¾ in. broken stone, trap rock, dolemite or limestone, 56,000 gal. resurfacing asphalt, 1,000 gal. joint filler, 12,000 gal. lignin binder. H. Snook, co. engr.; adv. E. N.-R. Mar. 12.

CRUSHED STONE, etc.—**Ridgefield, N. J.**—Mar. 17, by Bd. Boro Council, Boro Hall, tarvia and crushed stone for road improvement, 85,000. McClave & McClave, 600 Gorge Rd., Cliffside Park, boro engrs.

CEMENT—**Dickinson, N. D.**—May 10, by A. S. Wood, aud. Stark Co., portland cement in car

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Materials (Continued)

lots f.o.b. various stations, also in small lots delivered from yards at stations.

LUMBER, CURBING, etc.—**Cleveland, O.**—Mar. 13, by City, oak and pine lumber, 9,500 lin.ft. granite curbing, 2,000 tons emulsified Kold Patch mix and pavement crack-filler.

SLAG or LIMESTONE—**Cleveland, O.**—Mar. 20, by Bd. Comrs. Cuyahoga Co., 3,700 tons slag or 4,800 tons limestone. $16,600.

SURFACRETE, etc.—**Cleveland, O.**—Mar. 17, by Bd. Comrs. Cuyahoga Co., 25,000 gal. surfacrete, 1,000 tons sheet asphalt and 25,000 paving bricks.

SEWER PIPE—**Dayton, O.**—Mar. 16, by City Purchasing Agent, 402 U. B. Annex, 2,712 ft. 60 in. B and S precast concrete sewer pipe.

CREOSOTED TIES—**Phila., Pa.**—Mar. 24, by Dpt. City Transit, c/o C. E. Myers, City Hall Annex, 8,600 Type A, 100 Type B, 100 Type C 1,100 Type D, 3,800 Type AX, 525 Type BX and 5,480 Type E creosoted ties for subway.

SHELL—**Galveston, Tex.**—Mar. 17, by Comrs. Galveston Co., 30,000 tons shell, f.o.b. cars or chute at Texas City. Address County Eng. Dpt., Galveston.

BITUMINOUS MATERIAL—**Virginia**—Mar. 19, by State Hy. Dpt., Richmond, 8,830,000 gal. cold surface treatment, 1,369,000 gal. cold patching material, applying 4,633,500 gal. surface treatment material. H. G. Shirley, hy. comr.; adv. E, N.-R. Mar. 12.

ASPHALTIC ROAD OIL—**Wisconsin**—Mar. 17, by State Hy. Comm., and Committees Ashland, Barron, Bayfield, Burnett, Douglas, Polk, Rusk, Sawyer and Washburn Counties, at Telegram Bldg., Superior, $1,827,000 gal. Types C and CC asphaltic road oil.

ASPHALTIC CEMENT, etc.—**Milwaukee, Wis.**—Mar. 17, by Central Rd. Purchase, 1,600 tons penetration asphaltic cement; 200 tons filler; 375 tons cement; 50,000 gal. bituminous road surfacing material, light tar; 90,000 gal. bituminous road surfacing material, medium tar; 450,000 gal. bituminous road surfacing material, heavy tar; 10,000 gal. bituminous asphaltic road oil; 3,500 tons coarse asphalt sand; 9,000 cu.yd. lake sand; 15,000 tons binder stone; 1,900 tons stone dust. J. W. Nicholson, purch. agt.

CONTRACTS AWARDED

BRICK — **Minneapolis, Minn.** — F. S. Gram, city purch. agt., 2 million 3 x 4 x 8½ and 3 x 4 x 8½ in paving brick, to Purington Paving Brick Co., Galesburg, Ill., at $36.50 and $37.60 per 1,000 respectively. Noted Feb. 5.

ASPHALTIC CEMENT—**New York, N. Y.**—S. Levy, pres. Manhattan Boro, Municipal Bldg., 600,000 gal. asphaltic cement, to Warner Quinlan Co., 2 Park Ave., $23,160; 50,000 special granite blocks, to Hildreth Granite Co., 100 Nassau St., $6,000. Noted Feb. 19.

BITUMINOUS CONCRETE—**St. George, N. Y.**—J. A. Lynch, pres. Richmond Boro, Boro Hall, 1,000 tons bituminous concrete, to Vanbro Constr. Co., 24 Elizabeth St., West New Brighton, $11,250. Noted Feb. 10.

EQUIPMENT

PROPOSED WORK

TRACTOR—**Brea, Calif.**—Brea-Olinda Union High School Dist. purchasing Fordson tractor, standard width.

TRUCK—**Oceanside, Calif.**—City, E. T. Duchren, city water supt., purchasing 1½-ton truck for Water Dpt.

TRUCK—**Redondo Beach, Calif.**—City, C. C. Mongold, clk., purchasing 1½-ton truck with hydraulic hoist and dump body.

TRUCKS, MOWER, etc.—**San Jose, Calif.**—City purchsaing trucks for Park Dpt., $1,200 available; power lawn mower, $400; combination ambulance and police patrol $2,000 available; tractor for fire department, $2,000 available. W. Popp, city engr.

PUMP — **Galveston, Tex.** — City, c/o J. E. Pearce, mayor, soon takes bids new water pump at Alta Loma Station, $2,500. O. E. Casey, Galveston, waterworks comr.

BIDS ASKED

GRADERS—**Orange City, Ia.**—Mar. 11, at office Auditor Sioux Co., 3 power motor graders.

OXY-WELDING OUTFIT—**Fitchburg, Mass.**—V. Parker, 53 East St., in market for oxy-welding outfit, spraying outfit, auto repair tools.

TRUCK—**Warren, Minn.**—May 11, by L. G. Johnson, aud. Marshall Co., truck not less than 3-ton capacity.

ROAD ROLLER—**Hackensack, N. J.**—Mar. 16, by Hackensack Impvt. Com., Municipal Bldg., 12 ton gasoline road roller with scarifier adjustable less than 72 degrees diam., for road work. $5,000. F. Campbell, city engr.

STREET SWEEPER—**Hackensack, N. J.**—Mar. 16, by Hackensack Impvt. Comn., Municipal Bldg., 1 Elgin motor driven street sweeper. F. Campbell, city engr.

TRUCKS—**New York, N. Y.**—Mar. 20, by W. J. Flynn, acting pres. Bronx Boro, Crotona Park, 3rd and Tremont Aves., two 5 ton motor driven gasoline trucks (non-assembled).

BLADE GRADER—**Dickinson, N. D.**—May 11, by A. S. Wood, aud. Stark Co., one leaning-wheel 12- to 14-in. blade grader.

PATROL—**Alexandria, S. D.**—Mar. 18, by Hanson Co., c/o J. W. Winright, chn. Bd. County Comrs., 1 motor patrol.

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FOREIGN

England, Cardiff—Paramount Publix Theatres, Foreign Theatres Dpt., Paramount Bldg., New York, N. Y., plans motion picture theatre. To exceed $150,000. **Maturity indefinite.**

France, Paris—See "Federal Government" under Proposed Work.

Holland, Amsterdam—Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., plans manufacturing and assembly plant. To exceed $1,000,000. **Maturity about Apr. 1.**

Ireland, Dublin—Paramount Publix Theatres, Foreign Theatres Dpt., Paramount Bldg., New York, N. Y., plans motion picture theatre. To exceed $150,000. **Maturity indefinite.**

Commercial Buildings

RESIDENTIAL

BIDS ASKED

N. J., Asbury Park — See "Contracts Awarded."

N. J., Bayonne—See "Contracts Awarded."

N. J., North Bergen — See "Contracts Awarded."

N. J., Woodcliff—See "Contracts Awarded."

O., Cleveland—J. M. Naft, 115 East 197th St., taking bids 4 story, 65 x 230 ft., brick, Edgewater Dr. $200,000. M. Weis, 1836 Euclid Ave., archt. Noted Feb. 19.

O., Cleveland—Mar. 14, by **F. W. Striebinger**, archt., 1900 Euclid Bldg., 3 story basement, 83 x 100 ft., brick, steel, concrete, 2005 Schaaf Rd., for South Hills Development Co., H. Chester, 4169 Pearl Rd. $150,000.

Pa., Pittsburgh — Owner, c/o D. A. Crone, archt., 212 Oliver Bldg., bids about Mar. 12, 3 story, basement, 90 x 150 ft., brick, steel apartment.

Wash., Seattle — E. W. Morrison, archt., Lloyd Bldg., bids about Apr. 1, general contract 21 story, basement, 108 x 120 ft., terra cotta, cast stone apartment-hotel, 6th and Bell Sts., for Commonwealth Building Co., McDowall Bldg., $800,000.

CONTRACTS AWARDED

Calif., Los Angeles—Wilshire Income Properties Ltd., Subway Terminal Bldg., 10 story, basement, Class A, San Marino and Serrano Aves., to United Constructors Ltd., 627 Loomis St., $475,000.

N. J., Asbury Park—Jamesburg Lumber Co., Jamesburg, 11 story, basement, brick, steel, Grand Ave., separate contracts. $150,000. E. H. Schneider, 3rd Ave., Spring Lake, archt.

N. J., Bayonne—H. Zeik, 23 West 33rd St., 5 story, basement, 50 x 140 ft., brick, steel, West 33rd St., separate contracts. $175,000. C. Shilowitz, 26 Journal Sq., Jersey City, archt. Noted June 23.

N. J., North Bergen—J. Pucci, 964 Hill St., 3 story, basement, brick, steel, 1st Ave., separate contracts. $150,000. B. Singer, 921 Bergen Ave., Jersey City, archt.

N. J., Princeton—Princeton Impvt., Inc., c/o A. J. Thomas, archt., 2 West 46th St., New York, brick, steel, plain found., to Matthews Constr. Co., 285 Madison Ave., New York. Est. $1,000,000. Noted Jan. 16.

N. J., Woodcliff—Park Avenue Constr. Co., S. Jones, in charge, 981 Bergenline Ave., 3 story, basement, brick, steel, plain found., Park Ave., separate contracts. $150,000. B. Singer, 921 Bergen Ave., Jersey City, archt.

Ont., Hamilton—Royal Connaught Hotel Co., King St., E., W. J. Southam, pres., 14 story, 100 x 110 ft., brick, stone, hotel addition to Piggott Constr. Co., Piggott Bldg. Noted June 26.

CLUBS

PROPOSED WORK

N. J., Newark—I.O.O.F. Three Link Temple, Inc., 42 Hill St., general contract altering and constructing 4 story, basement, brick, steel temple and store addition. $150,000. D. R. Rizzolo, 625 North 6th St., archts. Bids in Project in abeyance. Noted Feb. 19.

N. Y., New York—National Bureau Y. M. C. A., 347 Madison Ave., bids after June 1, general contract negro branch Y. M. C. A., 174-184 135th St. $1,000,000. A. L. and J. C. Mackenzie, 5 East 57th St., archt. Noted Jan. 15.

BIDS ASKED

N. J., Orange—H. B. Marsh, archt., 7 East 48th St., New York, bids about Apr. 15, general contract 2 story, basement, brick, steel building, Oakwood St., for Y. M. C. A. (Colored Branch). 148 Central Ave. $150,000. Noted Feb. 26.

HOSPITALS

PROPOSED WORK

Mich., Ann Arbor—State Psychopathic Hospital plans by Fry & Kasurin, 1st Natl. Bank Bldg., 2 story, basement, 100 x 280 ft., brick, rein.-con., stone, steel, plain found., Catherine St. $330,000.

N. J., Jersey City—Jewish Hospital Assn., B. S. Pollick, chn., Laural Hill, Secaucus, 4 story, basement, brick, steel hospital, Fowler and Van Nostrand Aves. $1,000,000. **Maturity probably in June.** Architect not selected. Noted Feb. 19.

N. J., Preakness — Bd. Freeholders Passaic Co., Court House, Paterson, bids in May, general contract 3 story, basement, brick, steel hospital, detention home. $500,000. F. W. Wentworth, 140 Market St., Paterson, archt. Noted Feb. 12.

N. J., Weehawken—North Hudson Hospital, Park Ave., bids in June, general contract 5 story, basement, brick, steel nurses home, training school, Columbia Terrace. $350,000. Sullivan W. Jones & Associates, Inc., 25 West 45th St., New York, archts. Noted Dec. 18.

N. Y., Dongan Hills—Dpt. Hospitals, Municipal Bldg., New York, bids latter part March or April, nurses' home, at Sea View Hospital. $150,000. Noted Jan. 1.

N. Y., New Dorp (mail Staten Island)—Dpt. Hospitals, Municipal Bldg., New York, plans by J. Whitford, 56 Bay St., St. George, 3 story, 40 x 150 ft. dormitory, for Seaside Hospital. $200,000. **Maturity soon.** A. Jordan Bernstein, 40 East 49th St., New York, consult. engr., is preparing structural designs.

O., Massillon—Dpt. Welfare, A. T. Connar, Dpt. P. Wks., 9th and Oak Sts., Columbus, plans by R. R. Ridley, Ohio-Hartman Bldg., Columbus, 2 story, basement, 130 x 224 ft., with two 38 x 85 ft. wings, concrete, brick, stone administration and employees buildings, and auditorium at State Hospital, brick founds. $250,000.

BIDS ASKED

Ark., Benton—Mar. 26, by Arkansas Constr. Comn., State Capitol, Little Rock, J. M. Hill, chn. (2nd unit) hospital buildings, incl. employees home, assembly building, 4 patients, dormitories, cafeteria, 2 comfort stations, for Farm Colony State Hospital for Nervous Diseases, Saline Co. Mann, Wanger & King, Donaghey Bldg., Little Rock, archts.

Conn., Hartford — City, W. E. Batterson, mayor, taking bids 5 story, brick, steel, stone hospital, Vine St. $500,000. Ebbets & Frid, 15 Lewis St., archts. W. H. Walsh, 612 North Michigan Ave., Chicago, Ill., engr. Noted Nov. 27.

Conn., Greenwich — St. Luke's Convalescent Home, G. C. Clover, bids about Mar. 23, general contract convalescent home for children. W. S. Gregory, 180 Madison Ave., New York, archt. Noted Feb. 19.

Ill., Aurora—Mar. 25, by Schmidt, Garden & Erickson, archts., 104 South Michigan Ave., Chicago, superstructure, pipe trades, 5 story, L shaped, rein.-con., brick hospital, also altering old hospital, Lincoln and Weston Aves., for Copley Hospital. $400,000. Noted Jan. 15.

Ill., Chicago—Cook Co. Comn., County Bldg., bids about Mar. 27, 17 story, basement, rein.-con., brick, steel nurses' home, Lincoln and Polk Sts. $2,350,000. E. E. Hall, 123 West Madison St., archt. Noted Nov. 20.

La., New Orleans—Mar. 19, by M. H. Goldstein, archt., Amer. Bank Bldg., 4 story, basement, 51 x 136 ft., rein.-con., brick veneer, cast stone, terra cotta main building, concrete and pile found., also 2 story 30 x 140 ft. frame, stucco nurses home, Louisiana Ave., for Flint-Goodridge Hospital, 1566 Canal St.

Mich., Port Huron—W. Wyeth, archt., 314 Sperry Bldg., taking bids 3 story, basement, brick, steel, stone, rein.-con. hospital, plain found., for Port Huron City Hospital. $350,000. Noted Oct. 30.

N. Y., Brooklyn—Dpt. Hospitals, Municipal Bldg., New York, bids about May 1, general contract nurses' home, training school, at Kings County Hospital. $1,625,000. LeR. P. Ward, 205 East 42nd St., New York, archt. Noted Jan. 1.

N. Y., New York—Dpt. Hospitals, Municipal Bldg., bids about May 1, extending nurses' home at Fordham Hospital. $150,000. B. R. Swartburg, 2 West 46th St., archt. Noted Jan. 8.

R. I., Providence—Mar. 23, by Dpt. P. Buildings, 2 story, basement, brick city hospital, isolation ward addition, plain found. $150,000 or more.

CONTRACTS AWARDED

O., Cincinnati—Comrs. Hamilton Co., Court House, 6 story, basement, 54 x 151 ft., rein.-con., brick hospital, plain found., to Hodges Constr. Co., Chamber of Commerce, $510,932. Noted Apr. 24, 1930.

CHURCHES

PROPOSED WORK

Conn., Hartford—Beth Israel Synagogue, I. Wise, chn., 20 Charter Oak Ave., plans by C. Greco, 11 Beacon St., Boston, Mass., brick, stone synagogue, Farmington Ave. $150,000.

Mass., East Dennis—Quincet Neck Methodist Church Society, S. Sears, church. $200,000. Architect not selected.

N. J., East Orange — First Congregational Church, E. R. Holden, pastor, 2 North Grove St., brick, steel church. $150,000. **Maturity probably soon.**

N. J., Maplewood—Wyoming Community Church, bids after Mar. 23, general contract church, H. Upjohn, 430 Wyoming Ave., archt. Noted Sept. 25.

N. J., Westfield—A. R. Hennell archt., 636 Prospect St., soon lets general contract 3 story, basement, brick steel parish house addition, St. Pauls Ave., for St. Pauls Episcopal Church. $150,000. Noted Feb. 19.

N. J., Woodridge—First Presbyterian Church, R. H. Hughes, pastor, 430 Highland Ave., sketches 2 story, basement, brick, steel, North Ave. $150,000.

Que., Rigand — Order of Franciscan Missionaries of Mary, 4 story, 40 x 132 ft., fireproof juvenate building. $175,000.

BIDS ASKED

Conn., Hartford — St. Justin's Parish, F. P. Nolan, pastor, bids about Apr. 1, superstructure 1 story, basement, 62 x 150 ft., limestone,

Churches (continued)
Blue Hill Ave. $400,000. Whiton & McMahon, 805 Main St., archts. Noted June 19.

Conn., Middletown — Mar. 13, by St. Sebastian Roman Catholic Parish, A. Santolini, pastor, superstructure 1 story, basement, 65 x 125 ft., granite church, Washington St. $150,000. Noted Feb. 5.

N. J., Newark—R. Nordin, archt., 207 Market St., bids about June 1, general contract altering and constructing 2 story, basement, brick, steel Sunday school addition, Roseville and Sussex Aves., for Roseville Presbyterian Church, Roseville Ave. $150,000. Noted Feb. 19.

CONTRACTS AWARDED

N. J., South River—Conklin Methodist Church, South River, general contract 1 and 2 story, basement, tower, brick, steel, Main and Gordon Sts., to J. J. Check, 37 Hillside Ave., Sayreville; plumbing and heating, to F. A. Armstrong, 15 George St., electrical work, to W. Roth, South River. Est. $150,000. Noted Mar. 5.

O., Youngstown—Martin Luther Congregation, F. J. Schellhase, pastor, 109 East Wood St., 2 story, basement, brick stone, to Jos. Buchbert & Sons, 819 Mahoning Ave. Est. $200,000. Noted Jan. 29.

SCHOOLS

PROPOSED WORK

Calif., San Francisco — State of California plans by S. Heiman, 605 Market St., fireproof class room building for State Normal School, Buchanan St. $150,000.

Conn., Willimantic—Town, E. A. Case, altering and constructiong 2 story, basement, brick high school addition, Prospect and High Sts. $150,000. W. Poter, 22 East 17th St., New York, probable archt. **Maturity indefinite.**

Fla., Winter Park—Rollins College, H. Holt, pres., plans by Cram & Ferguson, 248 Boylston St., Boston, Mass., and Keihnel & Elliott, Seybold Bldg., Miami, Knowles Chapel building, colored stucco, artificial stone trim, hollow tile. $200,000.

Ga., Valdosta — Emory University, H. Cox, pres., expending $200,000, for athletic building program. Hentz, Adler & Schutze, Candler Bldg., Atlanta, archts. Robert & Co., Bona Allen Bldg., Atlanta, engrs.

Ill., Peoria—City, E. C. Fischer, supt. Bd. Educ., plans by Hewitt, Emerson & Gregg, Peoria Life Bldg., Junior High School, 3 story, basement, incl. 4 shops, science, music, art, gymnasium, cafeteria, Warren St. $800,000.

Ind., Michigan City—School Comrs. plans by S. P. Boonstra, Michigan City, Park Elementary School. 2 story, basement, rein.-con., brick, stone, incl. auditorium. $150,000.

Ind., Oldenburg—Franciscan Fathers Catholic Church, plans by Werking & Son, 2002 East Main St., Richmond, 2 story, basement, 60 x 135 ft., rein.-con., brick, stone school, incl. auditorium, gymnasium. $150,000.

Mass., Boston—Most Precious Blood Roman Catholic Church, E. Crowley, pastor, 43 Maple St., plans by Maginnis & Walsh, Statler Bldg., 3 story, basement, irregular sized, brick, stone convent, plain found., 39 Maple St. $150,000.

Mass., Boston—Suffolk Law School, c/o R. T. Jackson, archt., 44 School St., sketches altering and constructing 1 story, brick, steel top addition to Preparatory Law School, Hancock and Myrtle Sts. $150,000 or more.

Mass., Chicopee Falls—City, J. J. Desmond, supt. schools, elementary school. $150,000. Architect not selected.

Mass., Framingham—Town, R. Harney, chn. School Comn., altering and constructing high school addition, Union Ave. $150,000. Architect not selected.

Mass., Hamilton—Town, J. Lamson, chn. Selectmen, sketches by Morse & Dickinson, 25 Washington Sq., 2 story, basement, brick, stone high school. $150,000. Noted Jan. 22.

Mass., Holyoke—City, P. Wks. Dpt., revised plans by Geo. F. B. Alderman Co., 316 High St., 3 story, basement, 70 x 230 ft. and 65 x 75 ft., brick, steel, concrete vocational school, Pine Beech and Franklin Sts. $250,000. Former contract rescinded. Noted Jan. 8 under "Contracts Awarded."

Mass., Falmouth—Town, School Bd., A. L. Pattee, chn., new village grammar school. $175,000 appropriated. Architect not selected.

Mass., Leominster—School Comn. soon takes bids altering and constructing 2 story, basement, brick, stone school addition, plain found., Lancaster St. $150,000. M. A. Dyer Co., 1 Beacon St., Boston, archts. Noted June 19.

Mass., Marblehead — Town, School Com., altering and constructing rear addition to high school. $150,000 or more. Architect not selected.

Mass., Millis—Town, Building Com., H. Cushman, 2 story, basement, brick high school, Main St. $150,000. Architect not selected.

Mass., Milton (br. Boston) — Town, School Bd., will not build 2 story, basement, brick, Elliot St., this year. $150,000. Shepard & Stearns, 65 Franklin St., Boston, archts. Noted Nov. 27.

Mass., Newburyport—City, A. Gillis, mayor, City Hall, high school. To exceed $150,000. Architect not selected.

Mass., Newton—Sacred Heart Roman Catholic Church, T. A. Curtin, pastor, Centre St., sketches by T. G. O'Connell, 134 Newbury St., Boston, 2 story, basement, 2 wings, brick, stone school, plain found., Crescent St. $150,000-$175,000.

Mass., Norton — Town, School Bd., Senior High School. To exceed $150,000. Architect not selected.

Mass., Norwood — St. Catherine's Roman Catholic Church, J. F. Doherty, pastor, Nahatan St., and McLaughlin & Burr, archts., 38 Tremont St., Boston, soon let contract altering and constructing brick, steel school addition, concrete found. $150,000. Noted Feb. 26.

Mass., Quincy—City, T. F. McGrath, mayor, plans by Harper & West, 92 State St., Boston, altering and constructing 3 story, basement, brick, steel west wing addition to Junior High School, plain found. $150,000 or more.

Mass., Raynham — Town, E. W. Robinson, supt. schools, school addition. $150,000. F. I. Cooper, 47 Winter St., Boston, archt.

Mass., Rochester — Town, Bd. Selectmen, 2 story, basement, brick school. $150,000. Architect not selected.

Mass., Southbridge—Town, School Bd., grade school. $150,000. Architect not selected.

Mass., Springfield—City, C. J. Morrow, chn., Building Comn., plans by E. C. and G. C. Gardner, 33 Lyman St., brick, steel, concrete, technical high school addition, Elliott St. $400,000. Noted Jan. 8.

Mass., Townsend—Town, E. S. Bagley, chn. Selectmen, plans by C. R. Whitcher, Beacon Bldg., Manchester, N. H., and soon takes bids 2 story, basement, 120 x 120 ft., brick, stone school, plain found., Centre St. $150,000. Noted Jan. 15.

Mass., Waltham—City, P. J. Duane, mayor, City Hall, brick, school, South Side Sect. To exceed $150,000. Architect not selected.

Mass., Weston—Town, Building Comn., C. M. Palmer, Jr., sketches by R. H. Doane, 60 Batterymarch St., Boston, 2 story, basement, brick high school, School St. $225,000. Noted Jan. 22.

Mass., Winchester—Town, Bd. Selectmen, elementary school. $150,000 or more. Architect not selected.

Mich., Midland—Bd. Educ., plans by R. V. Gay, Clinton St., St. Johns, 2 story, basement, brick, steel, stone, rein.-con., plain found. $350,000.

N. H., Andover — Proctor Academy, C. B. Wetherell, sketches by Kilham Hopkins & Greeley, 9 Park St., Boston, Mass., 2 story, brick academy, on Campus. $150,000-$175,000. Noted Feb. 19.

N. J., Camden—Bd. Educ. plans by David & Dunlap, 1805 Walnut St., Phila., Pa., high school, 8th and Jackson Sts. $500,000-$750,000.

N. J., Carteret—Bd. Educ., 39 Central Ave., 2 story, basement, brick, steel, Washington Ave. and Lewis St. $150,000. **Maturity probably soon.** Architect not selected.

N. J., Jamesburg—Bd. Educ. plans by J. N. Pierson & Son, 198 Jefferson St., Perth Amboy, 2 story, basement, 85 x 185 ft., brick, steel high school, plain found. $150,000. Noted Feb. 12.

N. J., Jamesburg—Bd. Educ., sketches by J. N. Pierson & Son, 198 Jefferson St., Perth Amboy, 2 story, basement, 85 x 185 ft., brick, steel high school, Davidson Estate. $150,000. Noted Jan. 29.

N. J., Morgan—Bd. Educ., 2 story, basement, brick, steel. $150,000. **Maturity probably soon.** Architect not selected.

N. J., Newark—Bd. Educ., City Hall, 3 story, basement, brick, steel addition to Maple Ave. School, $150,000 or more; 3 story, basement, brick, steel addition to Peshine Avenue School, $150,000 or more. Maturity probably soon. Architect not selected. Steam heating.

N. J., Newark—Bd. Educ., City Hall Annex, 3 story, basement, brick, steel, plain found. $150,000 or more. **Maturity probably soon.** Architect not selected.

N. J., Newark—Bd. Educ., City Hall, brick, steel addition to Hawkins School, 9 Cortlandt St. $150,000 or more. **Maturity probably soon.** Architect not selected.

N. J., Newark—Bd. Educ., City Hall, 3 story, basement, brick, steel addition to Burnett School, 37-47 Eagles St. $150,000 or more. **Maturity probably soon.** Architect not selected.

N. J., North Brunswick — Bd. Educ. North Brunswick Twp., 2 story, basement, brick, steel, Boulevard Heights Sect. $150,000. Architect not selected.

N. J., North Brunswick — Bd. Educ. North Brunswick Twp., 2 story, basement, brick, steel, Fairfield Sect. $150,000. **Maturity probably soon.** Architect not selected.

N. J., North Brunswick—Bd. Educ. North Brunswick Twp., 2 story, basement, brick, steel, rein.-con. addition to Parsons School. $150,000. **Maturity probably soon.**

N. J., Springfield—Bd. Educ., Short Hills Ave., 2 story, basement, brick, steel high school, plain found. $300,000. **Maturity probably in May.** J. T. Simpson, 45 Walnut St., Newark, archt. Noted Feb. 12.

N. J., Union—Bd. Educ., 2 story, basement, brick, steel high school, plain found. $150,000. **Maturity about June.** F. A. Elsasser, 1000 Stuyvesant Ave., archt.

N. J., Washington—Bd. Educ. bids early in March. 2 story, basement, brick, steel high school, Carlton Ave. 150,000. C. G. Jones, 280 Bway., New York, archt. Noted Jan. 22.

N. J., West New York—Bd. Educ., L. V. Roth, pres., Municipal Bldg., School 3, 3 story, basement, brick, steel, plain found., 11th and Polk Sts. $150,000 or more. **Maturity probably soon.** Architect not selected.

N. J., Woodbridge—Bd. Educ., Barron Ave., 2 story, basement, brick, steel, Strawberry Hill. $150,000. **Maturity probably soon.** Architect not selected.

N. J., Westwood — St. Andrew's Parochial School, 86 Washington Ave., sketches 2 story, basement, brick, steel addition, Washington Ave. $150,000.

N. Y., Great Neck—Bd. Educ., 2 story, basement, brick, steel school. $150,000. Project in abeyance. Guilbert & Betelle, 20 Branford Pl., Newark, N. J., archt. Noted Mar. 5.

N. Y., Henderson—Central School Dist. plans by E. Hollenbeck, 212 Harrison St., Syracuse, new central school. $150,000.

N. Y., New York — Union Theological Seminary, Bway. and 120th St., 7 story dormitory, apartments known as McGiffert Hall, 99 Claremont Ave. $500,000. **Maturity in April.** Noted Feb. 5.

O., Hamilton — Bd. Educ. plans by F. G. Mueller & G. Barkman, Rentschler Bldg., 3 story, basement, brick, rein.-con. high school, plain found., Eaton Rd. $380,000.

Pa., Greentree—St. Margarets Roman Catholic Congregation, T. P. Butler, Popular St., member building com., plans by R. Marlier, Empire Bldg., Pittsburgh, 2 story, basement school, incl. social quarters, also church in basement, Mansfield and Greentree Rds. $150,000.

Pa., Lawrence Park—Bd. Educ., P. Gill, secy., plans by C. S. Kirby, 116 West 10th St., Erie, 2 story, 95x145 ft., brick, steel high school addition, incl. auditorium, gymnasium. Election Apr. 2, $150,000 for same.

Pa., Pittsburgh—Bd. Educ., H. W. Cramblet, secy., Administration Bldg., plans by Ingham & Boyd, Empire Bldg., Westinghouse High School, brick, steel, North Murtland Ave. $239,000. Noted Mar. 20, 1930.

Pa., Pittsburgh—E. P. Mellon and W. L. Smith, archts., Koppers Bldg., Pittsburgh, and 350 Madison Ave., New York, soon lets contract 1 story, 50 x 120 ft. library, 5th St. and Woodland Rd., for Pennsylvania College for Women. C. Coolidge, pres., Woodland Rd. $200,000.

R. I., Bristol — Town, E. S. Mapes, supt. schools, sketches by H. L. Meacham Associates, 120 Front St., Worcester, Mass., school. $125,000-$150,000.

R. I., Middletown—Howe & Church, archts., Turks Head Bldg., Providence, soon let contract 2 story, basement, brick infirmary, plain found., for St. George's School, c/o architect. $150,000. Noted Feb. 19.

S. D., Yankton — Yankton College, G. W. Nash, pres., plans by G. D. Elmslie, 122 South Michigan Ave., Chicago, Ill., 4 story, basement, men's dormitory, brick, steel, to be built in 4 units, campus. $150,000.

Tex., Dumas—Bd. Educ., c/o Secretary, plans by G. A. Carlander, Fisk Bldg., Amarillo, high school. $150,000.

Tex., Laredo—Bd. Educ., plans by Giesecke & Harris, Austin, school improvements. Election about May 1, $350,000, for same.

B. C., Vancouver—Bd. School Trustees plans by H. W. Postle, 590 Hamilton St., one 11 room and one 22 room and one 10 room high school additions, one 22 room junior high school, brick, rein.-con., concrete or stucco, plain found. $799,958. Board election in May for same.

Que., Montreal — Sisters of Ste. Anne de Lachine, convent at corner of Blvd. St. Michel and Belanger St. $250,000.

Que., Quebec City — Roman Catholic School Bd., A. C. Taschereau, secy., Parliament Bldgs., plans by R. Chenevert, 132 St. Peter St., school, Ste. Foye Rd. and Marguerite Bourgeous Sts. $180,000.

BIDS ASKED

Calif., Santa Barbara—Mar. 23, by Bd. Educ., part 1 and 2 story, rein.-con., school. $500,000. W. H. Weeks, 525 Market St., San Francisco, archt.

Conn., New Britain—Mar. 18, by City, J. M. Halloran, chn. Building Comn., brick, steel primary-elementary school, and brick, steel, limestone gymnasium, Bassett and Ellis Sts. $200,000. Warren E. Holmes Co., 112 East Allegan St., Lansing, Mich., archts. Noted June 5.

Fla., Tallahassee—Mar. 16, by State Bd. Control, wing addition to history building at Florida State College for Women. R. Weaver, Gainesville, archt., to board.

Ill., Chicago—Mar. 17 (extended date), by Bd. Educ., 188 West Randolph St., Wells Junior High School, concrete, cut stone, terra cotta, incl. lunch room, auditorium, library, power plant, civics, administration shops, swimming pool, drawing room, printing shop, Ashland, Augusta, Mansfield and Walton Aves. $2,000,000. P. Herhardt, c/o owner, archt. Noted Feb. 12.

Ind., Laporte—School Comrs., taking bids 2 story, basement, 78 x 217 ft., steel, brick, rein.-con. high school. $150,000. G. W. Allen, 209 Laporte Bank Bldg., archt. Noted Feb. 5.

Ind., South Whitley—Mar. 16, by Bd. School Comrs., C. Thompson, trustee, brick, steel school. $150,000. Griffith & Goodrich, 209 Bass Bldg., Ft. Wayne, engrs. Noted Jan. 8.

Ky., Louisville—Mar. 20, by Bd. Educ., 8th and Chestnut Sts., 2 story, part basement, 180 x 350 ft. irregular sized, rein.-con., brick, tile, stone. Bennett and Strader Sts. $250,000. J. M. Colley, c/o owner, archt.

Mass., Lexington—Mar. 14, by Town Bd. Selectmen and Kilham, Hopkins & Greeley, 9 Park St., Boston, altering and constructing 2 story, basement, brick, stone grammar school addition, plain found., East Lexington Dist. $150,000 or more. Noted Feb. 5.

Mass., Waltham—St. Mary's Roman Catholic Church, J. J. Baxter, 133 School St., taking

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Schools (continued)

bids altering and constructing 2 and 3 story, basement, brick parochial high school addition, plain found., Lexington St. $150,000. T. E. Sheehan, 120 Boylston St., Boston, archt. Noted Feb. 5.

Mich., Battle Creek—Mar. 16, by G. C. Furniss, secy. Bd. Educ., 2 story, basement, 80 x 285 ft., brick, steel, rein-con., stone school, plain found., Stiles St. $150,000. Albert Kahn, Inc., 1000 Marquette Bldg., Detroit, archts.

N. J., Glen Rock—Bd. Educ., Boro Hall, bids about Mar. 16, 2 story, basement, brick, steel addition to School 2. $150,000. Adams & Prentice, 15 West 38th St., New York, archts. Noted Feb. 12.

Pa., Knoxville—Mar. 17, by Bd. Educ. of Pittsburgh, Administration Bldg., Pittsburgh, Junior High School, 3 story, basement, 69 x 407 ft., brick tile, limestone, Charles and Grimes Sts. $350,000. P. C. Dowler, Century Bldg., Pittsburgh, archt.

Pa., Pittsburgh—Mar. 17, by Bd. Educ., H. W. Cramblet, secy., Administration Bldg., Elementary and Junior High School, 4 story basement, 240 x 250 ft., brick, steel, Southern and Prospect Aves. $600,000. J. T. Steen & Sons, Vandergrift Bldg., archts.

CONTRACTS AWARDED

Calif., Altadena—Pasadena Bd. Educ., general contract Junior High School, 2 story, rein.-con., brick, steel, to E. F. Wopschall, 35 North Bway., Pasadena, $245,028. Noted Jan. 29.

Conn., New Canaan—Town, Bd. Selectmen, 2 story, basement, brick, concrete Junior High school, concrete found., to T. J. Pardy Constr. Co., 1481 Seaview Ave., Bridgeport, $124,595, est. $225,000; heating to W. P. Kirk, 749 Main St., Bridgeport, $19,909 est. $225,000. Noted Jan. 29.

Md., Baltimore—Bd. Awards, 2 story, irregular sized, brick, hollow tile school addition, to C. L. Stockhausen Co., Gay and Water Sts., $109,898. Noted Feb. 10.

N. Y., New York — Union Theological Seminary, Bway. and 120th Sts., 7 story, basement, brick dormitory, apartment, to Edward Corning Co., 204 East 39th St. Est. $500,000. Contractor soon takes bids on separate contracts. Noted Mar. 5.

Ill., Chicago—Bd. Educ., 188 West Randolph St., E. Withall, bus mgr., general contract Verdie Junior High School, to J. Traff, 5806 West Division St., $404,000; asphalt roofing, to Luse, Stevenson Co., 307 North Michigan Ave., $7,970; sheet metal, to E. A. Rysdon & Co., 527 West 41st St., $14,725; structural steel, to A. Bolters & Sons, 2301 Ward St., $64,400; ornamental iron, to General Bronze Co., 228 North La Salle St., $10,085; carpentry, to Thorgerson & Erickson Co., 228 North La Salle St., $127,300; glass and glazing, to Tortenson Glass Co., 3233 Sheffield Ave., $15,750; plastering, to Babka Plastering Co., 130 North Wells St., $90,500; structural glass, to Sanitary Constr. Co., 1474 West Austin Ave., $38,250; heat regulation, to National Regulator Co., 2301 North Knox Ave., $7,200; coal and ash conveyor, to Link-Belt Co., 910 South Michigan Ave., $7,449. Grand total $787,620. Noted Jan. 1.

THEATRES

PROPOSED WORK

Calif., San Jose—United Artists Corp., 1966 South Vermont St., Los Angeles, plans by S. C. Lee, 714 West 10th St., Los Angeles, Class A, rein-con., steel theatre, 1st and San Salvador Sts. $150,000.

Calif., Stockton—National Theatres Syndicate, 25 Taylor St., San Francisco, plans by Bliss & Fairweather, Balboa Bldg., San Francisco, Class A rein-con., steel theatre, Main St. $175,000.

Mass., Boston—Fox Theatres Corp., 850 10th Ave., New York, theatre and office on Touraine Hotel site. $10,000,000. Project abandoned. Noted May 22.

Mass., Falmouth — B. A. Richardson, c/o Finance Corporation of New England, 31 Milk St., Boston, plans theatre, corner Main St. and Elm Arch Way. $150,000. Architect to be announced later.

N. J., Perth Amboy—Warner Bros. Pictures, Inc., 321 West 44th St., New York, will let contract about Apr. 1, 2 story, 105 x 235 ft., brick, rein.-con. theatre, store, Smith and Maple Sts. $1,000,000. J. Eberson, 370 Lexington Ave., New York, archt. Noted Jan. 22.

N. Y., White Plains—Warner Bros. Pictures, Inc., 321 West 44th St., New York, theatre, Mamaroneck Ave. between Main and Martine Aves. $150,000. **Maturity in May.** J. Eberson, 370 Lexington Ave., New York, archt. Noted Oct. 16.

BIDS ASKED

N. J., Red Bank—Boylan & Levine, archts., 143 Albany St., New Brunswick, bids about Mar. 15, 2 story, basement, brick, steel, plain found., for owner, c/o architect. $150,000. Noted Mar. 5.

CONTRACTS AWARDED

Ont., Ottawa — A. H. and S. Capland, new theatre, Rideau St., to A. I. Garoock, Sparks St., $235,000.

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BANKS

PROPOSED WORK

N. J., Asbury Park—Asbury Park & Ocean Grove Bank, 308 Main St., revised sketches probably by E. A. Arend, Kinmouth Bldg., 8 story, basement, brick, steel, rein.-con. addition, Main and Mathso Sts. $150,000 or more.

N. J., Plainfield—Mid-City Trust Co., 201 Front St., bids late in April, 2 story, basement, 40 x 150 ft., brick, steel, plain found., Watchung Ave. and East Front St. $200,000. Holmes & Winslow, 153 East 38th St., New York, archts. Noted May 23.

N. J., Stone Harbor—First National Bank, H. I. Taylor, pres., 1 story, basement, brick, steel bank. $200,000. **Maturity about November.** I. Glaser, 620 Madison Ave., New York, archt. Noted Oct. 23.

N. Y., Nyack—Nyack Natl. Bank soon lets general contract bank. To exceed $150,000. Holmes & Winslow, 153 East 38th St., New York, archts.

OFFICES

PROPOSED WORK

Conn., Hartford — Hartford Fire Insurance Co., 690 Asylum Ave., plans by E. S. Dodge, 15 Exchange St., Boston, Mass., brick, steel office addition. $150,000 or more.

N. Y., New York—Museum of Science & Industry of New York, 220 East 42nd St., office, tower, Grand Central Zone. $10,000,000. **Maturity indefinite.**

Tex., Laredo—W. Epstein, 10 story, brick, rein.-con., steel, stone office. $500,000.

BIDS ASKED

Conn., Bridgeport — Mar. 17, by Bridgeport Hydraulic Co., 820 Main St., 2 story, 70 x 120 ft., brick, steel, stone office, Main and Gilbert Sts. $150,000. E. G. Southey, 955 Main St., archt. Noted June 5.

CONTRACTS AWARDED

Calif., Sacramento—H. Mitau, 1422 40th St., 16 story, basement, Class A, rein.-con. office, to Lindgren & Swinerton, Inc., California State Life Bldg., $800,000. Noted Dec. 18.

N. J., Newark — F. A. Phelps, archt., 21 Fulton St., general contract 3 story, basement, brick, steel office, to E. M. Waldron, Inc., 40 Park Pl., for Eagle Fire Insurance Co., 18 Washington Pl. Est. $150,000. Noted Feb. 26.

N. Y., New York — United States Trust Co. and Bankers Trust Co., 45 Wall St., 25 story office and bank addition, to Thompson-Starrett Co., 250 Park Ave. Est. $5,500,000. Noted Feb. 12.

STORES

PROPOSED WORK

N. J., Newark—W. E. Lehman, archt., 972 Broad St., taking preliminary bids general contract 2 story, basement, brick, steel store, apartment, plain found., Clinton and Hillside Aves., for Bratter & Pollack, 972 Broad St. $150,000.

N. J., Union City—S. Slatkin, 17 Oak St., Wechawken, 3 story, basement, brick, steel store, office, 169-173 Summit Ave. $150,000. **Maturity probably soon.** F. W. Woolworth Co., Woolworth Bldg., New York, lessee.

Pa., Johnstown—H. M. Rogers, archt., Johnstown Trust Bldg., soon lets general contract 5 story, basement, 93 x 127 ft., brick, steel side addition to department store, Locust St. near Franklin St., incl. wrecking 1 story building on site, for Glosser Department Store, Franklin St. $250,000.

Pa., Pittsburgh—Janssen & Cocken, archts., Century Bldg., soon let contract 4 story, basement, 20 x 80 ft., brick, limestone store and loft, 443 Wood St., for Singer Sewing Machine Co., 149 Bway., New York. $150,000.

BIDS ASKED

Conn., Hartford—I. Wise, Wise Smith & Co., Main St., taking bids 3 story, basement, 40 x 140 ft., brick, steel store, Main St. $150,000. Ethan Allen Dennison Assn., 36 Pearl St., archts.

N. J., Orange—C. Messina, 52 North Day St., bids about Mar. 15, 3 story, basement, brick, steel store, apartment, 52 North Day St. $150,000. **Harris & Sohn, 17 Stickle St.**, Newark, archts. Noted Mar. 5.

N. J., Palisades Park — Owner, c/o P. J. Jossier, archt., 240 Broad Ave., bids about May 1, general contract 2 story, basement, brick, steel store, apartment, Broad Ave. $150,000.

PUBLIC

PROPOSED WORK

Ark., Russellville — COURT HOUSE — Pope Co., c/o H. M. Spaulding, clk., plans by H. R. Burke, Wallace Bldg., Little Rock, 3 story, basement, 54 x 120 ft., rein.-con. $150,000 voted for same. Noted Feb. 19.

Ga., Gainesville—COURT HOUSE—Comrs. Hall Co., sketches by W. J. J. Chase, 140 Peachtree St. N. E., Atlanta, brick, stone, rein.-con., hollow tile. $150,000.

Minn., Rochester—CITY HALL—City probably rein-con., brick. $150,000. A. F. Wright, city clk.

N. J., Emerson — BORO HALL — Bd. Boro Council, F. Pascarella, mayor, 2 story, basement, brick, steel. $150,000. **Maturity probably soon.** Architect not selected.

N. J., Englewood — MUNICIPAL — Bd. City Council, Municipal Bldg., altering Liberty School, 3 story, basement, brick, steel, into municipal building, Liberty St. $150,000. **Maturity probably soon.** Architect not selected.

N. J., Hackensack — MUNICIPAL — Hackensack Impvt. Comn., City Hall, will not build 3 story, basement, brick, steel, 1st St. $200,000. Project abandoned. Noted May 29 Daily.

Ill., Rock Island — ARMORY — State of Illinois, Rock Island Naval Reserve, c/o K. A. Madden, 123 Essey Lane, Davenport, Ia., sketches armory, 18th St. Architect not selected.

Mass., Attleboro—POLICE STATION—City, F. E. Briggs, mayor, City Hall, central police station. $150,000 or more. Architect not selected.

N. C., Waynesville — COURT HOUSE and JAIL—Haywood Co., R. T. Boyd, chn., comrs., new court house and jail. $230,000.

N. D., Bismarck — CAPITOL — State capitol building. $2,000,000.

O., Cleveland — DETENTION HOME — Bd. Comrs. Cuyahoga Co., F. J. Husak, clk., plans by F. W. Bail, Hanna Bldg., 2 and 3 story, brick, steel, concrete, 60 x 180 ft. juvenile court building, 40 x 165 ft. dependents building, 40 x 230 ft. delinquents building and 30 x 165 ft. service building, East 22nd St. and Central Ave. $1,850,000.

Pa., Phila.—COURT—Bd. Comrs. Allegheny Co., G. F. Holmes, pres., plans by J. T. Windrim, Commonwealth Bldg., and bids about June 25, brick, steel, rein.-con., Parkway St. $325,000.

Tex., Lubbock—JAIL—Lubbock Co., c/o E. L. Pitts, judge, plans by S. B. Haynes, Myrick Bldg., 3 story, basement, brick, rein.-con., plain found. $100,000. Noted Apr. 17.

BIDS ASKED

Ind., Indianapolis—POLICE RADIO BUILDING—Mar. 17, by City, Bd. Safety, W. O. Lewis, secy., brick, steel, Willard Park, State and Washington Sts. $175,000.

Mass., Watertown—ADMINISTRATION, etc. —Mar. 14, by Town, J. P. Barrett, chn. Building Comn., and R. C. Sturgis, archt., 120 Boylston St., Boston, 2 story, basement, 100 x 100 ft., brick, limestone, concrete administration building and police station, concrete found., Main St. $205,000. Noted Mar. 5.

Mass., Worcester — MEMORIAL — City bids about Apr. 15 general contract municipal memorial auditorium, Lincoln Sq. $2,000,000. H. G. Balcom, 10 East 47th St., New York, engr. L. H. Briggs Co., Worcester, and F. C. Hirons, 40 East 49th St., New York, archts. Noted Dec. 11.

N. J., Morristown — JAIL, etc. — Apr. 8, by Bd. Freeholders Morris Co., Court House, county office building and county office jail, Court and Ann Sts. Palmer & Plonksy, 55 William St., New York, archts.; adv. E. N.-R. Mar. 12. Noted Jan. 29.

CONTRACTS AWARDED

Kan., Goodland—COURT HOUSE—C. W. Jupe, clk. Sherman Co., general contract 3 story, basement, 70 x 107 ft., rein.-con., brick, Bedford stone, terra cotta, to Blazer-Vollmar Constr. Co., Wichita, $97,750. Noted Feb. 19 .

UNCLASSIFIED

PROPOSED WORK

Md., Baltimore—REMOTE DELIVERY and GARAGE—J. E. Sperry, archt., Calvert Bldg., soon lets contract 2 story basement, 142 x 202 ft., brick, rein-con., Josephine St. between Pine and Arch Sts., for Stewart & Co., Lexington and Howard Sts. Noted July 31.

Mass., Brookline — EXCHANGE — New England Telephone & Telegraph Co., 50 Oliver St., Boston, plans by R. C. Sturgis, 120 Boylston St., Boston, and soon takes bids altering and constructing 3 story, basement, 40 x 170 ft., brick, limestone, steel addition to Aspinwall Exchange, plain found. $150,000. French & Hubbard, 210 South St., Boston, engrs. Noted Mar. 27.

Mass., Lynn — EXCHANGE — New England Telephone & Telegraph Co., 245 State St., Boston, plans by Densmore, LeClear & Robbins, 31 St. James St., Boston, and takes bids early in April, 3 story, basement, brick, stone, steel, concrete, City Hall Sq. $700,000. Noted Feb. 5.

N. J., Jersey City—HOME—Hebrew Home for Aged, M. Hurwitz, chn., 161 Summit Ave., plans by C. Shilowitz, 26 Journal Sq., Jewish Home for Aged, 3 story, basement, brick, steel, Fowler and Van Nostrand Aves. $150,000. Noted Sept. 26 Daily.

N. J., Newark—MARKET—Newark Farmers Market, Inc., G. Haines, pres., 1218 Broad St., Bloomfield, fifty 1 story, basement, 20 x 60 ft., brick buildings for farmers' market, Cornelia, Catherine and Joseph Sts., Lister, Albert and Euclid Aves. $400,000. **Maturity probably in June.** Architect not selected. Noted Feb. 19.

N. J., Passaic — EXCHANGE — New Jersey Bell Telephone Co., 540 Broad St., Newark, general contract brick, steel. Prospect St. $150,000. **Maturity about August.** Voorhees, Gmelin & Walker, 101 Park Ave., New York, archts. Noted Nov. 20.

R. I., Providence—EXCHANGE—New England Telephone & Telegraph Co., 245 State St., Boston, Mass., plans by Densmore, LeClear & Robbins, 31 St. James Ave., Boston, Mass., and takes bids latter part of month, 2 story, basement, 60 x 120 ft., brick, steel, stone, Broad and Eddy Sts. $150,000.

BIDS ASKED

N. Y., New York—ART MUSEUM—Park Bd., W. R. Herrick, pres. Park Dpt., Arsenal Bldg., Central Park, bids about May 1, general contract 2 and 3 story museum, Metropolitan

Unclassified (Continued)

Museum of Art, 5th Ave. from 80th to 84th Sts. $3,350,000. J. R. Pope, 542 5th Ave., archt. E. E. Seelye, 101 Park Ave., structural engr. Tenny & Ohmes, 101 Park Ave., mechanical engrs. Noted Feb. 12.

CONTRACTS AWARDED

N. J., Newark—MERCANTILE—R. B. Flatt, archt. 600 Bloomfield Ave., Bloomfield, general contract 1 story, brick, steel, rein.-con., to Enstice Bros., 111 Academy St., for Gude & Cole, 74 Clinton St. Est. $150,000. Noted Feb. 5.

O., Cincinnati — STATION, etc. — Cincinnati Union Terminal Co., Temple Bar Bldg., furnishing, fabricating 24,500 tons structural steel for terminal buildings for freight and passenger stations, to R. C. Mahon Co., 8650 Mt. Elliott Ave., Detroit, Mich. Est. $1,500,000. Owner now taking bids due Mar. 25, on remainder of work. Noted Dec. 4.

Industrial Buildings

FACTORIES AND MILLS

PROPOSED WORK

Calif., Santa Ana—PRE-COOLING PLANT—Village Park Orchards Assn., sketches 2 story, full basement pre-cooling plant. $75,000.

Me., Dixfield—FACTORY—Berst-Foster-Dixfield Co., F. W. Smith, mgr., West Peru, sketches 2 story, brick, timber addition. $40,000. Private plans.

Mass., Medford (br. Boston) — MANUFACTURING—Somerville Iron Fdry. Co., 83 Washington St., Somerville, M. D. Bingham, pres., soon takes bids 1 story, 55 x 150 ft., concrete, steel, concrete found., concrete piers. Mystic Ave. $50,000-$60,000. Noted May 29.

Mich., Marysville—GLASS MANUFACTURING PLANT—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., glass manufacturing plant, rail and water terminal. To exceed $200,000. **Maturity indefinite.**

Miss., Jackson—FACTORY, etc.—N. W. Overstreet, archt., Mississippi Fire Insurance Bldg., soon lets contract 1 factory, 2 warehouses, 5 outbuildings, 50,000 sq.ft. floor space, rein-con. found., for International Match Co., 25 West 43rd St., New York. $80,000.

N. H., Durham—DAIRY—University of New Hampshire, Durham, plans by E. T. Huddleston, superv. archt., Durham, dairy at State College. To exceed $40,000.

N. J., East Rutherford — FACTORY — East Rutherford Syringe Co., 75 Mozart St., 2 story, basement, brick, steel, 54 Mozart St. $40,000. Project in abeyance. J. T. Camlet, 26 Piaget Ave., Clifton, archt. Noted Feb. 26.

N. J., Elizabeth—CHEMICAL PLANT—Allied Tar & Chemical Corp., D. W. Blaine, pres. and genl. mgr., South Bayway, rebuilding brick, steel, Richmond St. $40,000. Project in abeyance. Architect not selected. Noted Feb. 26.

N. J., Jersey City—FACTORY—Jersey City Ladder Co., Inc., 677 Montgomery St., will not build 2 story, basement, 45 x 140 ft., brick, steel, foot Cranford St. $50,000. Project abandoned. B. Singer, 92 Bergen Ave., archt. Noted Feb. 19.

N. J., Newark—FACTORY—Weldon Roberts Rubber Co., 18 Oliver St., will not build 2 story, basement, brick, steel addition, 361-65 6th Ave. $40,000 project abandoned. M. N. Shoemaker, 10 Bleecker St., archt. Noted Feb. 12.

N. J., North Bergen—FACTORY—Cinderella Slipper Co., M. Eisenberg, pres., 5700 Hudson Blvd., will not rebuild 3 story, basement, 50 x 100 ft., brick, steel, Hudson Blvd. $75,000. Project abandoned. Noted Feb. 26.

N. J., Orange — FACTORY — See "Contracts Awarded."

O., Cleveland — LAUNDRY — Christian, Schwarzenberg & Gaede, archts. and engrs., 1836 Euclid Ave., soon lets contract 2 story, basement, 100 x 105 ft., brick, steel, timber addition, for Union Towel & Supply Co., C. M. Roskoph, pres., 2319 East 34th St. $50,000.

Okla., Shawnee—E. A. Liebman, 1214 West 18th St., Oklahoma City, sketches raw water ice plant. $90,000. Private plans.

Pa., Pittsburgh — FACTORY — Mayer Body Corp., c/o W. G. Mayer, 6459 Frankstown Ave., soon lets contract 1 story, 30 x 100 ft., and 2 story, 50 x 100 ft. brick, concrete steel additions, 6461 Frankstown Ave. Lake & Davidson, Negley Bldg., archts.

Pa., Tarentum—MILL—Tarentum Steel Co., A. W. Barrett, pres., Pittsburgh, also V. P. Miller Printing Mchry. Co., 1117 Reedsdale St., Pittsburgh, steel mill. $1,500,000. L. F. Galbraith, Tarentum, engr. Noted Mar. 20, 1930.

R. I., North Smithfield — PLANT — Branch River Wool Combing Co., A. Picavet, treas., sketches, sorting plant and storage building, Branch Village. Est. exceeds $40,000. Lockwood Greene Engrs. Inc., 24 Federal St., Boston, engrs.

R. I., Providence—PLANT—C. Moulton Stone Co., 456 Benefit St., taking bids 2 story leather finishing building, brick, timber, Winchendon St. $50,000. F. E. Field, 5 Euclid Ave., archt. Noted Feb. 5.

Tenn., Chattanooga — DAIRY — Southern Dairies Co., Inc., 14 East 7th St., dairy, Dodson Ave. $100,000. **Maturity about Mar. 30.**

Tenn., Chattanooga — TEXTILE MILL — Davenport Hosiery Mills, 906 Georgia Ave., plans additional unit, 11th St. $75,000.

Que., St. Hyacinthe—HAIRPIN FACTORY—Hump Hairpin Co., 1918 Prairie Ave., Chicago, Ill., plans hairpin factory, St. Anne St., $125,000-$150,000. Dakin Constr. Co., Belmont St., Montreal, probable general contractor.

BIDS ASKED

Mass., Taunton — MANUFACTURING — Taunton Pearl Wks., 35 Vernon St., taking bids remodeling 2 story, basement, brick, timber manufacturing building. $50,000. Jackson & Moreland, Park Sq. Bldg., Boston, archts.

N. J., New Brunswick—BAKERY—A. Vella, 182 Remsen Ave., taking bids 2 story, basement, brick, steel, Livingston Ave. $40,000. H. G. Bach, 63 Schureman St., archt. Noted Mar. 5.

Pa., Pittsburgh—BAKERY—Mar. 13, by P. R. Scheueneman, archt., Magee Bldg., 3 story, basement, 50 x 115 ft., brick, concrete, 204 North Denniston Ave., for Haller Baking Co., F. C. Haller, pres., 204 North Denniston Ave.

CONTRACTS AWARDED

Calif., Los Angeles — BAKERY — Helms Bakeries Ltd., 8800 Venice Blvd., 1 and part 2 story, 197 x 231 ft., rein.-con., brick, steel, 8800 Venice Blvd., to Hamm, Grant & Bruner, 607 Ferguson Bldg., $110,000.

Conn., Higganum — BOTTLING PLANT — Undina Beverage Co., B. A. Benson, vice-pres., 2 story, 75 x 125 ft., brick, timber bottling plant to G. H. Birdsey, 2 Russell St., Middletown. Est. $50,000. Noted Jan. 29.

N. J., Newark — SODA WATER PLANT — M. J. Cook, 235 Rose St., general contract altering 2 story, basement, brick, steel, Rose St., to Levine Bros., 519 South 14th St. Est. $40,0000.

N. J., New Brunswick—FACTORY—Metallo Gasket Co., 16 Bethany St., general contract 2 story, basement, brick, steel, addition, Bethany St., to Milltown Realty & Constr. Co., Main St. Est. $40,000.

N. J., Orange—FACTORY—T. Sangiacomio, Collins St., 3 story, basement, brick, steel, plain found., 160-64 South St., separate contracts. $40,000. Former bids rejected. A. P. Nucciarone, 206 Central Ave., archt. Noted Jan. 29.

N. Y., Brooklyn—FACTORY—Empire State Bag Co., 760 Wythe Ave., general contract altering factory, to W. Rieger, 451 West 54th St. Est. $40,000. Noted Mar. 5.

O., Akron — FACTORY — Anderson Rubber Co., 124 North Union St., 2 story, 74 x 109 ft., brick, steel, Bettes Corner, to Krumroy Contg. Co., 225 West Exchange St., $50,000.

Ore., Portland — FACTORY — Western Oil & Refining Co., Central Bldg., Los Angeles, Calif., oil storage, concrete fire wall, 3 pump houses, dock, oil tanks, dredging, pipe lines for oil plant on 5 acre tract, to Kern & Kibbie, 290 East Salmon St., $100,000.

Pa., Pittsburgh — PRINTING PLANT — Herbick & Held Co., 1117 Wolfendale St., 1 story, brick, steel addition to Austin Co., 16112 Euclid Ave., Cleveland, O. Est. $50,000.

Tex., Beaumont—BOTTLING PLANT—Cocoa Bottling Co., c/o J. M. Acker, mgr., bottling plant, Ashley St. between Gulf and Mariposa Sts. $150,000. Owner builds. A. C. Johnson in charge. Pringle & Smith, Norris Bldg., Atlanta, Ga., archts.

GARAGES

PROPOSED WORK

N. Y., Brooklyn—Goal Serv. Station, Inc., 478 Leonard St., sketches by H. J. Nurick, 44 Court St., service garage, Leonard St. and Engert Ave. $40,000.

N. Y., New York—Dpt. Hospitals, Municipal Bldg., bids in April or later, general contract garage at City Hospital, Welfare Island. $150,000. B. R. Swartburg, 2 West 46th St., archt. Noted Jan. 8.

N. Y., New York—Dpt. Parks, W. J. Herrick, pres. Park Bd., Arsenal Bldg., Central Park, soon takes bids garage, shop, and office building, Bronx Park Zoo and Birdall Ave. $125,000. J. Dusenbury, 2382 Grand Concourse, archt. Noted Feb. 19.

N. Y., New York—Rosario Gangi, 3978 Paulding Ave. plans by F. J. Roos, 4200 White Plains Ave., 3 story service garage, tenements, 225 St. and Paulding Ave. To exceed $50,000.

O., Cleveland — Goldman Bros., genl. contractors, 524 East 110th St., plans by G. Rudolph, 6409 Quimby Ave., 2 story, basement, 80 x 266 ft., brick, steel, concrete garage, Fairfield Ave. $150,000.

Tex., Laredo — Gateway Chevrolet Co., 2 story, 70 x 150 ft., brick, rein.-con. garage, plain found. $70,000. Private plans.

BIDS ASKED

N. J., East Orange — Rocco Realty Co., M. Rousek, mgr., 507 Main St., bids about Mar. 15, general contract 2 story, basement, brick, steel, rein.-con. auto laundry, garage, Main St. and North Arlington Ave. $150,000. Noted Mar. 5.

N. Y., Flushing—Polk Realty Corp., 26 Court St., Brooklyn, bids about October, general and separate contracts 100 x 198 ft. service garage, 39th Ave. and 170th St. $65,000. J. Millman, 67 Court St., Brooklyn, archt. Noted Feb. 26.

N. Y., Richmond Hill (sta. Staten Island)—See "Contracts Awarded."

N. Y., Woodside—See "Contracts Awarded."

CONTRACTS AWARDED

Ariz., Phoenix—P. Bennett, Phoenix, service buildings, sales rooms, gasoline and oil distributing islands, service court, to G. F. Williams, Phoenix. Est. $100,000.

Ind., Elkhart—Texas Oil Co., rein.-con., brick, steel superservice station, 916 South Main St. $40,000. Owner builds. Private plans.

N. Y., Richmond Hill (sta. Station Island)—Mymand Constr. Co., 6730 75th St., Middle Village, service garage, Gould and Addison Aves., separate contracts. $40,000. M. Perlstein, 6735 75th St., Middle Village, archt. Noted Feb. 26.

N. Y., Woodside—Mymand Constr. Co., 6730 75th St., Middle Village, 100 x 125 ft. service garage, separate contracts, $40,000. M. Perlstein, 6735 75th St., Middle Village, archt. Noted Feb. 26.

SHOPS AND FOUNDRIES

BIDS ASKED

Me., Oakland — FOUNDRY — See "Contracts Awarded."

N. Y., Brooklyn — SHOP — Dpt. Hospitals, Municipal Bldg., New York, bids about May 1, shop, mechanical and garage, at Kings County Hospital. $450,000. LeR. P. Ward, 205 East 42nd St., New York, archt. Noted Jan. 15.

N. Y., Flushing—REPAIR SHOP—A. Beaudel, 140-34 Brookville Blvd., Rosedale, bids about Apr. 10, general and separate contracts 2 story, Brookville and Conduit Blvd. $40,000. Private plans. Noted Feb. 26.

CONTRACTS AWARDED

Me., Oakland—FOUNDRY—Getchell Foundry & Machine Co., C. W. Getchell, rebuilding 1 and 2 story, concrete and timber foundry and wood turning mill recently destroyed by fire. $50,000. Day labor. Private plans. Noted Feb. 5.

POWER PLANTS

CONTRACTS AWARDED

Ill., Chicago — Commonwealth Edison Co., 72 West Adams St., masonry and carpentry contract 59 x 70 ft. power plant, 6161-63 Prairie Ave., to P. Warren, 2532 Warren Ave., $40,000; masonry contract 3 story, 38 x 124 ft. service building addition, 2201-09 Throop St., to Otto Randolph & Co., 53 West Jackson Blvd., $45,000.

Ind., St. Meinard — St. Meinard Abbey, 3 rein.-con. transformer stations, incl. steel doors, equipment. $40,000. Owner builds. E. C. Berendes, 121 Northwest 4th St., Evansville, engr.

WAREHOUSES

PROPOSED WORK

N. J., Newark—R. V. Bassert, Jr., 160 Maple St., West Orange, will not build brick, steel warehouse, garage, Delevan Ave. $150,000. Project abandoned. Noted Dec. 11.

N. Y., Long Island City—Pittsburgh Plate Glass Co., 16 East 40th St., New York, and Rex Cole, Inc., lessee, 4th Ave. and 21st St., New York, altering service storage and manufacturing building, 193 Hunters Point Ave. $100,000.

N. Y., New York — H. Kahre, 175 West 79th St., plans by J. H. Gray, 175 High St., Boston, Mass., 2 story, storage and service building, 100 West 50th St. $75,000.

N. Y., New York — Port of New York Authority, 80-90 8th Ave., bids about July, general contract 14 story, 200 x 800 ft., rein.-con., brick freight terminal, 8th and 9th Aves., 13th and 14th Sts. $9,000,000. Abbott, Merkt & Co., 175 5th Ave., archts. Noted Jan. 8.

N. Y., New York — Spear & Co., 575 6th Ave., will let contract in April, 10 story, 100 x 145 ft. warehouse. $500,000. L. Davidson, 104 West 42nd St., archt. Noted Jan. 29.

Tex., Fort Worth—Texas Pacific Ry. Co., E. F. Mitchell, ch. engr., Dallas, soon takes bids 80 x 600 ft., brick, outbound warehouse.

BIDS ASKED

Calif., San Francisco—Mar. 19, by California State Bd. Harbor Comrs., Ferry Bldg., extending cold storage and refrigeration plants, installing machinery and equipment, Channel and 3rd Sts.

Conn., Greenwich — Drinkwater Sons, Inc., 122 Railroad Ave., taking bids (from selected list bidders), 6 story, basement, 50 x 90 ft. warehouse, Railroad Ave. $125,000-$150,000. Fletcher-Thompson, Inc., 1336 Fairfield Ave., Bridgeport, archts.

N. J., Camden — Mar. 18, by South Jersey Port Comn., U. S. Jeffreys, secy., 106 Market St., general contract 2 story, 160 x 300 ft., brick, rein.-con. warehouse and railroad siding, Delaware River front between Clinton and Pine Sts. $500,000. C. W. Stamford, 50 Church St., New York, engr. and archt. Noted Feb. 19.

N. Y., West Brighton — Mar. 18, by J. A. Lynch, pres. Richmond Boro, Boro Hall, St. George, storage building, incl. concreting yard, Clove Rd. Yard.

Tex., Beaumont—Wilson Packing Co., U. S. Yards, Chicago, Ill., taking bids 2 story, 75 x 150 ft. cold storage plant. $100,000. Private plans.

See proposal advertising on page 113

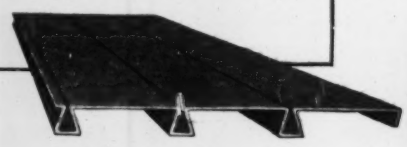
Const. News page 109

This "whaleback" roof on the Paramount Theatre, Fort Wayne, equipped with a Fenestra Holorib Roof unit. Architect: A. M. Strauss. Contractor: Max Irmscher & Sons.

A STEEL-DECKED "WHALEBACK"

18-Point Holorib Roof Deck

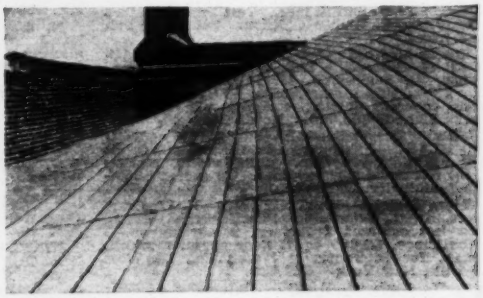
1 A copper bearing steel roof deck, combined with sufficient insulation to prevent condensation.
2 A long-lived roof, requiring a minimum of maintenance.
3 Its light weight reduces the requirements of the structural steel—(one square foot of Holorib weighs approximately 5 lbs., including insulation and water proofing.)
4 Carries required loads over wide purlin spacing with ample factors of safety.
5 Makes a firm, smooth and inherently dry mopping surface for the application of insulation and roofing felts. The affinity of its component parts gives it a much longer life than other roofs.
6 Quickly laid. Speeds the completion of the building.
7 May be laid in any weather men can work—nothing to pour—nothing to freeze—nothing to dry out.
8 Applicable to flat, pitched, saw-tooth, monitor, bowstring or curved surfaces.
9 Unaffected by atmospheric changes. Expansion and contraction are negligible.
10 Saves winter fuel. Provides cooler interiors in warm weather.
11 Saves insurance. Takes a fireproof rating when used over incombustible contents.
12 Telescoping end laps made over the purlins form tight interlocking joints.
13 Triangular reinforcing ribs running longitudinally in the sheet form a continuous beam that rests directly on the purlins.
14 May be welded in place forming a rigid yet self-adjusting foundation for insulation and waterproofing.
15 Lower in cost than any other types of fire-resistive roof of the same insulating efficiency.
16 Provides attractive ceilings. It is not a dust collector.
17 May be used as a highly satisfactory floor with or without concrete.
18 Fenestra Sanacoustic Holorib provides an economical sound absorbing ceiling and roof in one unit.



Note the strong triangular ribs.

Light weight, flexible, but exceptionally strong, Fenestra Holorib makes an ideal deck for "whalebacks" and other roofs, irregularly curved.

Such a foundation, covered with insulation and built-up roofing is particularly suitable for theatres, such as this Paramount at Fort Wayne, Indiana.



15,700 square feet of 20-gauge Fenestra Holorib used.

Fenestra Holorib sheets are formed with triangular ribs, strong to withstand wind pressure and snow loads. Yet, they are flexible enough to conform to unusual roof design without precurving at the factory. We have recently perfected Sanacoustic Holorib which may be used to form, in one unit, an economic, sound-absorbing ceiling and roof.

Note 18 Fenestra Holorib advantages in the list opposite, and before you buy a steel deck, check all the facts regarding design and load-carrying capacity.

Fenestra Holorib is backed by Detroit Steel Products Co., oldest and largest steel window maker in America. Free engineering and designing service is available from the nearest Holorib or Fenestra representative. Look under "Fenestra" in your telephone book.

DETROIT STEEL PRODUCTS CO.
Fenestra Holorib Division
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